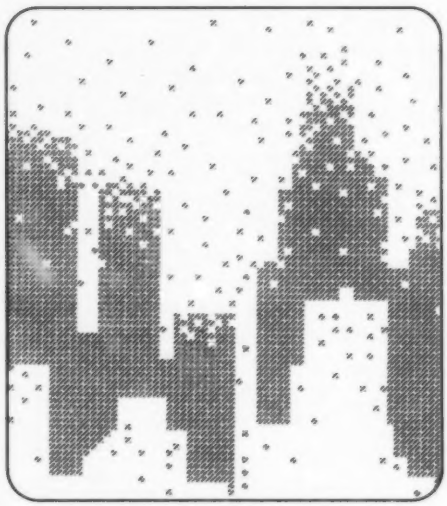
Canadian Centre for Occupational Health and Safety
Centre canadien d'hygiène et de sécurité au travail



ASBESTOS IN BUILDINGS

A Workshop

P91-1E

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ASBESTOS IN BUILDINGS

A WORKSHOP

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This proceedings of the Asbestos in Buildings Workshop, September 11 and 12, 1990, in Laval, Quebec, includes the presentations of panelists, discussions, and reports of work groups. It has been edited for publication in consultation with panelists and work group leaders.

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CCOHS CCHST

EXECUTIVE SUMMARY

Serious concerns exist about the health risks of asbestos in buildings to occupants of those buildings and to operations and maintenance workers. CCOHS had planned to follow its highly successful workshop on Man-Made Mineral Fibres in October 1989 with a workshop on Asbestos in Buildings at the end of January 1990 in Hamilton. A planning committee met immediately after the Man-Made Mineral Fibres workshop and started to work on the asbestos one. However, because of the contentious nature of the topic, particularly in that area at that time, the Council of Governors of CCOHS decided to postpone and later to relocate the workshop.

The chosen locale was in Quebec, and in April a new planning committee met in Montreal at the offices of the Institut de recherche en santé et en sécurité du travail (IRSST) to set up the CCOHS/IRSST workshop on Asbestos in Buildings. The members of the planning committee were Louis Berlinguet of the IRSST, Robert Bouchard of the Quebec Federation of Labour, Scott Houston of the Asbestos Institute, Howard Lucas of the Saskatchewan Construction and General Workers' Union, Bill Denault, a private consultant, and Mario Di Pesa of the Canadian Federation of Labour - Quebec. And for their assistance in the planning, the promotion, and the support of this workshop, we are extremely grateful. The workshop was held on September 11 and 12, 1990, at the Sheraton Laval Convention Centre.

The participants were welcomed by the presidents of the sponsoring organizations, Louis Berlinguet of the IRSST and J Arthur St-Aubin of CCOHS. Outstanding presentations by Brooke Mossman of the University of Vermont College of Medicine, and Bette Meek of Health and Welfare Canada on health effects of low level exposure were followed by a fine and comprehensive review of options and regulations by Don Pinchin. He often used the Ontario Royal Commission Report on Asbestos as an authoritative reference source, as did others, both in the presentations and in the discussion groups. Melanie Stoughton of the Scarborough Board of Education described her Board's smoothly-functioning management and removal program and found herself fielding many questions. Serge Trudel, Director of Occupational Health and Safety of the Quebec Federation of Labour convincingly conveyed a labour perspective on the protection of workers through training, qualifications, and prevention programs. Guy Perrault of the IRSST ably described the most current information on synthetic fibres and summed up the recommendations of the CCOHS Man-Made Mineral Fibres workshop.

Mixed work groups chaired by Alex Turner, Peter Wrzesien, Jean-Serge Denis and Robert Bouchard discussed the questions of public awareness, communications and responsibility, and enforcement. The profound discussions and conviviality continuing over dinner showed how well the groups had functioned--and bilingually, too, with the assistance of interpreters and much goodwill and accommodation.

Conclusions reached were that asbestos in good condition did not present a hazard for occupants of buildings; that a management plan was needed to ensure asbestos was in good condition or was properly removed; that there must be legislation adequate to protect

workers; that workers involved in removal of asbestos must be trained; and that contractors should be accredited. There was agreement that information must be available on all synthetic or natural fibres, and it was recommended that tendering documents include recommendation for the replacement material or options along with information concerning those materials.

There was a strong call for a Royal Commission or Green Paper on all fibres, natural or synthetic, in the workplace and in the environment. The report of the Ontario Royal Commission on Asbestos was again and again quoted as the source document--participants felt there should be adherence to its principles. Public awareness was seen as a major need.

During the workshop, notice came of a school that had been closed in Toronto because asbestos had been found. Richard Boehnke of the Department of Public Health for Toronto attending the workshop said "One cannot underestimate the importance of the work that we are doing here today. This is not just another seminar; the fears, the trepidations, the panic are real."

CCOHS Governor, Robert Bouchard, of the Quebec Federation of Labour, expressed his pleasure at this successful joint effort of CCOHS and IRSST. In his closing words, Louis Berlinguet said that he, too, was extremely pleased with this collaborative effort which he termed "entirely desirable." He summed up the salient points of discussion in a few words and assigned responsibility:

1. Knowledge--scientists. There is good knowledge about asbestos, but more research is still needed on other fibres.

2. Management--managers of buildings, public and private.

3. Control, regulation--governments. Various Ministries, each with some responsibility, must work together.

4. Training, information dissemination--/all of us--the media, organizations, associations, unions, scientists, governments.

To the planning committee, the speakers, the work group leaders, the rapporteurs and all the participants--many thanks.

Canadian Centre for Occupational Health and Safety

IRSST
Institut de recherche en santé et en sécurité du travail du Québec

ASBESTOS IN BUILDINGS

A Workshop

Tuesday, September 11 and Wednesday, September 12, 1990
Sheraton Laval Convention Centre, Laval, Quebec

Tuesday, September 11, 1990

8:15 am	REGISTRATION AND COFFEE - Terrebonne/Rosemère Foyer
9:00 am	**Introduction** Lillian Vine, Manager, Workshops and Conferences Canadian Centre for Occupational Health and Safety
	Welcome Louis Berlinguet, Directeur-Général Institut de recherche en santé et en sécurité du travail du Québec
	J Arthur St-Aubin, President Canadian Centre for Occupational Health and Safety
9:30 am	**Health Effects of Low Level Exposure** Brooke Mossman, Associate Professor University of Vermont, College of Medicine
	Bette Meek, Acting Head, Environmental Criteria Section Health and Welfare Canada
	Questions and Discussion
10:45 am	COFFEE BREAK - Foyer
11:00 am	**Asbestos Control Options and Overview of Regulations** Don Pinchin, President Pinchin & Associates Ltd
11:30 am	**Perspectives:** **Building Owner Perspective** Melanie Stoughton, Occupational Health and Safety Advisor, Scarborough Board of Education
	Questions and Discussion
12:30 pm	LUNCH - Des Prairies
1:30 pm	**Labour Perspective--Training, Qualifications & Preventive Programs** Serge Trudel, Director, Occupational Health & Safety Quebec Federation of Labour

2:00 pm **Other Mineral Fibres**
Guy Perrault
Institut de recherche en santé et en sécurité du travail

Questions and Discussion

3:00 pm COFFEE BREAK - Foyer

Workshops 1 and 2 - Mixed Work Groups

3:15 pm **Workshop #1 - Public Awareness, Communications & Responsibility**

a) What information is made available to workers? to occupants of buildings? to the public?
b) What is the level of public awareness of risks and control options?
c) What are the perceptions? Based on what?
d) How do you balance perceptions?
e) What information is needed? How is it communicated? Whose responsibility is it?
f) What are the Public Health aspects of the issue?

4:30 pm **Workshop #2 - Enforcement**

a) How are workers protected in demolition, removal and maintenance?
b) How are decisions made?
c) How do you monitor the option decision?
d) When/Why do you review the decision?
e) How do you enforce the appropriate measures to safeguard safety for workers and occupants?

5:30 pm CASH BAR - Des Prairies
6:00 pm DINNER

Wednesday, September 12, 1990

8:30 am COFFEE - Foyer

9:00 am **Workshop #3 - Homogeneous Groups**

a) How can we make the best use of public funds?
b) How can we deal better with the issue than we are doing now?

Preparation of Report to Plenary Session

10:30 am COFFEE BREAK - Foyer

10:45 am **Plenary Session - Terrebonne/Rosemere**
Conclusions and recommendations

12 noon **Close of Workshop**

CM POINTS
The Canadian Board of Occupational Medicine will award 11 hours of CME Study Credits for participation at this workshop. CCOHS has applied for accreditation for participation to the American Board of Industrial Hygiene.

INTRODUCTION

Lillian Vine

Good morning, ladies and gentlemen. I am Lillian Vine, Manager of Workshops and Conferences for the Canadian Centre for Occupational Health and Safety. I am very glad to be in Montreal to present this workshop in collaboration with the Québec Institut de recherche en santé et en sécurité du travail, or IRSST. All the sessions will be bilingual; interpretation will be provided in each group. The workshop was set up with the help of a planning committee; I would like to very briefly but very sincerely thank the members of the Committee--Louis Berlinguet, Bill Denault, Scott Houston, Howard Lucas, Guy Perrault, Robert Bouchard--who are all here with us today.

Patricia Dyke organized the interpretation services. We have the assistance of my assistant, Barbara Kuchynski, Hélène Lemieux of CCOHS, and Ginette Tremblay, assistant to Mr Berlinguet of the IRSST. My director, John Crick, will be here presently. The president of CCOHS is with us as well.

I would like to introduce Louis Berlinguet who will welcome you to the workshop. Mr Berlinguet is the Director General of the IRSST. It was my pleasure to work with him on this workshop, and I hope it will not be the last time.

Louis Berlinguet

Good morning, Mrs. Vine, ladies and gentlemen. Welcome to Montreal. I am very glad you accepted our invitation to participate in this workshop which we organized together with the Canadian Centre for Occupational Health and Safety. We were most pleased to help organize this workshop because the Québec Institut de recherche en santé et en sécurité du travail believes asbestos is a dangerous substance which we ought to be thoroughly familiar with; it has been the subject of many studies.

As for all the processes, substances or products of modern technology, I think the users must be thoroughly familiar with the dangers involved as well as the benefits we derive from the chemical and physical properties of these products. And to give due consideration to both the dangers and the benefits, it is important to have a thorough knowledge of the subject based on precise, objective research. Whether it be asbestos, cigarette smoking, the automobile, radiation, any of the issues in our age of rapid development, the information must be disseminated objectively so our discussions can be interesting and enlightened.

This is why we decided to begin with presentations that give an overview of what is known on asbestos and its dangers. Then when we divide into smaller groups, we will discuss the measures necessary to find a balance between the dangers and the benefits to the users and the workers. We are most pleased to welcome you here today.

Now I want to introduce to you my co-president Arthur St-Aubin. Mr St-Aubin is the new president of the Canadian Centre for Occupational Health and Safety in Hamilton. He assumed his new responsibilities only a few months ago, but already we feel his presence at the Centre. We were very glad to learn of his appointment to this position.

Mr St-Aubin did his studies here in Montreal, at Brébeuf College which is run by the Jesuits. This training helped him greatly in his nearly 30-year career with the Canadian Armed Forces. The various positions he held with the Forces took him all over the world, to Korea and the Middle East among others, where he was always part of the "peacemaker forces," whose role it was to keep the peace between opposing factions. This may be one of the reasons he was appointed president of CCOHS where there is also an equilibrium to maintain between employers and workers.

Mr St-Aubin's skills as an administrator equipped him for a career with the Public Service Commission after he left the military. He did a lot of work at the PSC in the area of training middle and senior managers. So everything pointed to his becoming the president of a Centre where there is a lot of discussion and where parties who often hold different opinions must reach a consensus.

Welcome to this symposium, Mr St-Aubin. I believe this may be the first time you are participating in a joint sumposium. We are very pleased. Mr St-Aubin.

J Arthur St-Aubin

Dr Berlinguet, ladies and gentlemen, I would like to say a brief word of welcome in addition to what my co-president, Mr Berlinguet, has already said.

It is a pleasure to be with you this morning. It reflects the joint nature of this workshop; it reflects a new orientation for the Centre. A Centre that is going to be far more outward looking; a Centre that is in search of ideas. In search of cooperation, the sharing of ideas and opinions. This new orientation is aimed at establishing a closer link with research centres, universities, workplaces, industry, and trade unions, and will bring us much closer to where things happen so we can be up-to-date in relation to the ideas being discussed.

I would like to thank Mr Berlinguet and his team for the warm welcome we have received. Without the support of the IRSST and in particular of Mr Berlinguet and his team and the planning committee, I do not think there would have been any workshop here today. So we are very grateful, Mr Berlinguet, for all your support, not only in the material sense but also for your intellectual and moral support. It is a pleasure to cooperate with the Institut and we hope to have many occasions to do so again in the future.

Finally, what's a nice guy like me doing in a place like this you wonder? You have probably been reading the various press clippings that said that I don't have an enormous amount of background on the professional side of health and safety--true, not in the sense of scientific or clinical research. On the other hand, I have spent almost 30

years at the operational end dealing with high explosives, heavy equipment, bridge building, road construction and so on. It was thought that my managerial background and my operational experience working with large numbers of people in heavy work and construction might be of advantage to the Centre.

I find my work at the Centre tremendously satisfying. The people are devoted and completely sincere. We believe the new orientation we have embarked upon will be to everyone's benefit. I thank you.

Lillian Vine

Mr Berlinguet and Mr St-Aubin, thank you very much. When we were organizing this workshop, the planning committee met at the IRSST in Montreal in April and received the same very warm reception we are receiving here today. We decided that our speakers at this workshop should be Brooke Mossman, Bette Meek, Don Pinchin, Serge Trudel, Guy Perrault, and someone in charge of asbestos in a large school board. As you can see, we were completely successful.

Every person that we asked to speak agreed. I think that you have a very fine slate of speakers. Their addresses will give you an excellent background. They will be followed by mixed groups in which you will be discussing several questions; other questions you will be discussing in homogeneous groups. Each of these groups is chaired by a workshop participant--someone who registered to come to the workshop and whom I called last week to ask to do extra work. I met yesterday with Peter Wrzesien, Alex Turner, Robert Bouchard and Jean-Serge Denis who will chair the work groups.

The final plenary session will consist of reports of the conclusions and recommendations of the homogeneous groups. The presentations and the final plenary will be published in a proceedings. I will try my hardest to do it by year end.

HEALTH EFFECTS OF LOW LEVEL EXPOSURE

Brooke Mossman, University of Vermont

Bette Meek, Health and Welfare Canada

ASBESTOS CONTROL OPTIONS AND OVERVIEW OF REGULATIONS

Don Pinchin, Pinchin & Associates

CCOHS/CCHST

Lillian Vine

I will introduce our first speaker, Dr Brooke Mossman of the University of Vermont.

The planning committee met in April 1990 shortly after the publication in Science of an article of which Brooke Mossman was the principal author. We were very impressed with that article and decided to ask her to speak.

Dr Mossman is an Associate Professor of the Department of Pathology, University of Vermont College of Medicine in Burlington, Vermont. She has authored more than 80 research articles and book chapters on mechanisms of asbestos-induced lung disease and is the first author of the article in the January issue of Science, "Asbestos: Scientific Developments and Implications for Public Policy." She is a member of the Scientific Advisory Board (Metal Subcommittee) and the Human Exposure and Health Effects Review Panel of the Environmental Protection Agency (EPA). She is also a member of the Scientific Advisory Committee of the American Cancer Society, the Pulmonary Diseases Advisory Committee of the National Heart, Lung and Blood Institute, and the National Institute of Occupational Safety and Health (NIOSH) Board of Scientific Counselors (Fiber Subcommittee). She was a member of the National Academy of Science Committee on Non-occupational Health Risks of Asbestiform Fibers.

Brooke Mossman

It is pleasure to be invited to speak today. In the January 1990 issue of Science, I and four co-authors, including Jean Bignon from Unite INSERM de Recherche sur la Biopathologie et la Toxicologie Pulmonaire et Renale in Creteil, France, Dr Morton Corn from Johns Hopkins University, Dr Bernard Gee from Yale University and Dr Antony Seaton from the Institute of Occupational Medicine in Edinburgh, published a paper which described recent scientific developments in the field and their implications for public policy.

I would like to highlight briefly some of the features of the article and the new data on health effects that were summarized therein.

One of the points we stressed in the article was that when one looks at different types of asbestos and considers their importance in the disease process, one has to consider them individually and not as a group. The regulatory agencies in the United States, such as the EPA, have lumped asbestos types into one group and do not consider the different pathogenic potential or the different ability of different asbestos types to cause health risks.

I would like to emphasize that asbestos is not one but a variety of different types of minerals which are both physically and chemically distinct. The type that is mined in Canada and the type that has accounted for about 90% of the world's production of asbestos over the last two decades is chrysotile asbestos. This is a serpentine asbestos in that it is pliable and curly in its fibrillar nature. It is a magnesium-containing silicate and is referred to commonly as white asbestos.

On the other hand, there are a variety of other asbestos types which we can lump collectively under the term "amphiboles." These include crocidolite (blue asbestos) which is mined in parts of South Africa, anthophyllite which was once mined in Europe, and other types that are less important industrially. Other types of asbestos, such as tremolite or actinolite, are found as contaminants of other types of asbestos. Most notably, tremolite is associated with certain deposits of chrysotile asbestos.

The properties of asbestos are different physically and chemically and structurally. Chrysotile fibres can be long and curly in nature or, in other preparations, they can be short. It is believed that in the lung after periods of time, the short-fibre chrysotile is broken down by lung cells and is leached by lung fluids. Thus, fibres become shorter in nature and disappear from the lung.

On the other hand, amphibole asbestos is a more rod-like fibre. Many of us have worked with this (UICC) preparation which is comprised of both short and long fibres and thick fibres versus thin. It has been difficult, because of these heterogeneous size preparations, to really get down to the features of asbestos that cause damage to cells and cause disease. Many of us have used chemically identical but non-fibrous preparations of asbestos-like minerals, such as riebeckite (which is chemically similar to crocidolite) but are particles. They have an overall geometry of a < 3 to 1 length to diameter ratio, whereas the definition of a fibre (at least in our regulatory agencies) is something with a > 3 to 1 length to diameter ratio.

The point that we make in our article is that you must use rather sophisticated techniques, such as energy dispersive X-ray spectrometry to differentiate between different amphibole types of asbestos. To identify different types of asbestos, one has to resort to sophisticated and expensive technology.

One point that has not been grasped by the American public is that for asbestos fibres to cause disease they must be inhaled. They must be of a certain size and dimension to be inhaled and penetrate the deep lung. It is important to understand the various pathways leading down to the terminal lung and that fibres must be inhaled to cause disease. A number of larger fibres are excluded due to nasal hairs. There are other defense mechanisms in the lung as one goes down deeper into the respiratory tract, such as cells which produce mucin and cells which eat the asbestos and attempt to clear it from the lung. The important point is that for a fibre to be disease-causing, it must enter the deep lung and bypass the normal clearance mechanisms.

In the article, we examined the current data base to determine low level exposures; that is levels of asbestos that are found in buildings and schools and would present a risk to human health. We reviewed the human data--that is the considerable amount of data on disease in workers not only in this country but in other countries and we reviewed the experimental studies--what animal inhalation experiments have told us. We also reviewed studies of mechanisms which have indicated to us how asbestos causes disease. We presented for the first time in a medical journal the results of two large-scale studies on airborne measurements of fibres in buildings. I would like to highlight some of these studies.

There is no doubt that asbestos in the past workplace caused disease. The three diseases that have been found in a large number of cohorts include lung cancer (bronchogenic carcinoma), pulmonary fibrosis (asbestosis) and mesothelioma. Two of these are malignancies. They result when different cells of the respiratory tract are transformed

or become cancerous after exposure to asbestos. The cells that give rise to these diseases are different in their origin in the lung. It is thought, however, that they give rise to disease because they encounter asbestos after it is inhaled. But they are "different target" cells. The target cell of lung cancer is called an epithelial cell which is the cell that lines the airways that divide further until they get down to the actual air exchange units of the lung.

As the fibres work themselves out to the periphery of the lung they encounter cells called fibroblasts which are thought to be the target cells of pulmonary fibrosis or asbestosis. In this condition, although this is technically a non-malignant disease, severe stages cause severe disability and death in workers. In this disease, the lung becomes less able to expand causing difficulty breathing and eventually the lung becomes filled with fibrous matter that prevents it from contracting. Therefore, these people often die of pulmonary insufficiency.

On the other hand, there is another malignant disease, mesothelioma, in which the target cell is a mesothelial cell--the cell type which lines the cavity which encloses the lung and the gastro-intestinal tract. This is called the pleural mesothelium, and the membrane that surrounds the gastro-intestinal organs is called the peritoneal mesothelium. Perhaps this is the most relevant disease when we talk about low level exposure. We don't know how the fibres get out to these cells and give rise to cancer. We know certain characteristics of these fibres that are important in causing disease in animals, but we have yet to understand how the fibres, after they enter the lung, work themselves out to these lining cells.

In the past, before workplace standards, workers were exposed to high concentrations of asbestos and it has been put forth to many school systems in the United States that perhaps these situations are akin to what happens in buildings and schools today.

I would like to discuss these diseases as they relate to the occupational setting and then talk a little about the levels of asbestos in buildings and schools and how we can make comparisons between occupational and non-occupational settings.

A few words first about asbestosis. I emphasize that this is a chronic disease in severe states and is non-malignant. It is an occupational disease in that, since the enactment of workplace standards and in workers who have been exposed since the 1970s, there has not been an increase in the disease. In fact, this is a disease that is considered as declining in modern day society under proper occupational standards. There have been studies both in the workplace and in experimental models, most notably those by Raymond Begin at the University of Sherbrooke, which have shown that there are levels of exposure below where this disease does not develop. That is, there are safe levels of asbestos both in these experimental models and in the workplace and there must be a certain crucial concentration of asbestos for disease to develop.

I should stress that asbestosis has been associated with exposure in the workplace to both chrysotile and various types of amphibole asbestos.

In our article, we mentioned pleural plaques as a marker of exposure to asbestos and asbestos-like fibres which can be observed on chest x-rays. However, we state that these pleural opacities or areas on the lung are not associated with decreased lung function.

Therefore, we and others have not considered pleural plaques to be a disease but a marker of exposure to asbestos and asbestos-like fibres in the workplace. Since our report in Science, there have been reports, mainly in the American press, that certain school custodians in the New York area experienced an increase in pleural plaques. This information has not been published as yet in the peer-reviewed scientific literature and so it is difficult to assume what is going on. It should be stressed that pleural plaques increase with age; there has been some documentation that they are exacerbated by cigarette smoking, and there are a number of confounding factors. I bring this point up only as a word of caution. Should these studies indicate that custodians or people with brief episodic exposure are, in fact, exposed to asbestos, they should be watched. There is a correlation between pleural plaques and asbestosis in some studies, but this is currently a controversy in the scientific community.

Let's talk about lung cancer as far as its general characteristics. In the United States about 130,000 cases are reported annually. The majority of cases are smoking-related, and the EPA has estimated that the second predominant cause of lung cancer is radon exposure. The average latency period (the time of first exposure to either cigarette smoking or asbestos and the actual development of the disease) is about 20 to 30 years. So, like all the asbestos-related diseases, it is a long period of follow-up. We examined in the Science article the various cohort studies and the influence of smoking and relied on reviews such as Rodolpho Saracci's from the International Agency for Research on Cancer (IARC) in Lyon. The influence of cigarette smoking in the induction of the disease is seen most strikingly in studies of insulation workers. As many of you might have realized, this is a cohort that was exposed to chrysotile and amosite asbestos. Of these 17,800 workers, 467 of 471 cases of this disease were reported in smokers. Four tumours were found in non-smoking asbestos insulation workers. One important feature of this disease is that depending upon the cohorts studied (the occupational group), if one combines smoking and exposure to asbestos, one gets an increase in disease which might be weaker in some situations and stronger or multiplicative in other situations.

Since the 1970s, there have been several studies from England, by Newhouse and Berry most notably, in which there have been low lung cancer risks mainly in chrysotile workers and specifically in individuals who manufactured friction materials. These individuals have shown (since the enactment of occupational standards) no increased risk of lung cancer. I should emphasize the environmental work that has been done by Andrew Churg in Quebec, in which he has looked at the residents of the Thetford mining area and shown that upon autopsy these individuals have a 10-20 fold higher lung burden of asbestos fibres than the general population; these are people who are exposed in their towns to levels of chrysotile as high as 500 times what is found in some US cities. Examination of these individuals shows that they have no increased risk of lung cancer.

In many cohorts exposed to high concentrations of asbestos, the risk of lung cancer or the standard mortality ratio over time is dose related. There is a different risk between certain cohorts; most notably the textile industry indicates a very high dose-response relationship whereas chrysotile miners, friction product workers, cement workers and individuals involved in manufacturing appear to have less risk of lung cancer.

The disease which is most relevant to low level exposure is the tumour, mesothelioma. In comparison to lung cancer, it is a very rare tumour--approximately 1,500 to 2,000 cases

are reported annually in the United States as opposed to 130,000 lung cancers. The average latency period is a little longer than lung cancer--35 to 40 years. In 1987, Enterline and Henderson published a paper where they presented the incidence of mesothelioma in the United States in men and women of various age groups. We find, from this data, that the disease in the last decade or two is only increasing in men over 65 years of age and not increasing in women in the United States in any age group. 80% of the cases are associated with occupational exposure to asbestos or para-occupational exposure (household exposure) to asbestos. We discussed in detail in these articles current information suggesting that the amphibole types of asbestos are implicated as the causative agents in mesothelioma.

At a symposium at Harvard University, Dr Douglas Liddell summarized evidence that shows a gradient of risk in the development of mesothelioma according to fibre type. If you look at the percentage of total mortality, that is the number of mesotheliomas occurring in these groups in comparison to total deaths, you can see that with exposure to amphibole asbestos (that is the insulation workers exposed to chrysotile and amosite) and in groups exposed to crocidolite as well as in groups exposed in shipyards there is a gradient of risk as far as the number of tumours. However the work by Churg indicates that chrysotile miners are from areas where the mines have a small percentage of tremolite and one can see that the risk from mesothelioma is decreased appreciably in comparison to the amphibole or mixed exposed groups.

The experimental data also point out other factors that might be important in the development of mesothelioma. There is overwhelming evidence, both in inhalation models and in injection models, that longer fibres (> 5 microns) cause mesothelioma in the animals, whereas shorter fibres are inactive and particles are very inactive. The longer fibres are also those which cause chromosomal changes indicative of cancer in a number of in vitro test systems. These are cell cultures where mesothelial cells or other cell types are scanned after exposure to various types of asbestos of various sizes and dimensions. It is the longer fibres that cause transformation or chromosomal alterations indicative of incipient cancer in these cell types.

There are other properties of asbestos that have been associated with toxicity and disease. The penetration of fibres into the lung is important. Experiments by Timbrell have shown that chrysotile fibres in bundles often get trapped in airways and have less ability to penetrate the deep lung whereas the amphibole types of fibres, being rod-like, can align themselves with airflow and enter the deep lung more effectively. The durability of fibres also appears to be important. The amphiboles are more durable than chrysotile fibres. Many of us have worked on agents which are generated from fibres called active oxygen species; these reactions appear to be motivated or induced by iron on the surface of fibres and these are thought to play a role in amphibole toxicity as well. The size of the fibres is extremely important.

What are the airborne concentrations of asbestos, what were they in the past workplace, and how do they relate to what we see in buildings and schools today? In the Science article we presented the first of two large-scale studies which have been followed up by a letter to Science from another individual who has also done large surveys and come up with the same types of measurements.

I should stress that in many past workplace settings we have no idea what workers were exposed to. We don't have good measurements of fibres in the workplace. This was due to the lack of sophisticated equipment and the fact that they didn't have techniques such as electron microscopy which allows us to look at fibres of fine dimensions. But there are some rough measurements and these are from two different studies. Dr McDonald's and Dr Liddell's work on chrysotile miners and millers showed a range of concentrations which were reported in individuals who had developed mesothelioma. There have been measurements in US naval shipyards by Langer et al. What are these in relationship to the current NIOSH standard? In the school survey completed by Dr Corn, there was an average level of 0.00024 fibres per cubic centimeter air over an 8 hour time adjusted average at the time of maximal activity in the buildings. We also published a preliminary study by the EPA in which they focused on a total of 387 samples in 3 categories of buildings. In 83% of the samples there was no asbestos detected. The technique used was transmission electron microscopy. I should emphasize that in this study there was also some indication of levels in outdoor air which are more or less comparable to levels in the buildings and schools.

An important aspect of the EPA study was that they surveyed buildings and classified them by visual inspection into three categories. The first category was perceived to have no asbestos-containing material; the second category had asbestos-containing material in good condition; and the third category had asbestos-containing material in poor condition (damaged asbestos). There appears to be no trend between the severity of the damage and the levels in air. In fact, statistical analysis showed that all the levels were similar to each other and similar to levels in outdoor air.

We emphasized in the Science article that types of asbestos are different chemically, physically and structurally. In comparison to chrysotile, amphibole types of asbestos are retained for longer periods in the lung. This is taken from both experimental data and studies on lung burdens in asbestos workers. Most notably, the insulation workers in the United States as analyzed by Langer were overwhelmingly exposed to more chrysotile than amphiboles in the workplace; however, the amphibole types of asbestos are found in all the lungs of the deceased and not all of the lungs of the deceased illustrate that chrysotile is there as well.

When one looks at disease in the workplace or in the non-occupational setting, one has to consider the fibre type, the size of the fibre and the airborne concentration of asbestos as that which can cause the potential health problem. Chrysotile is the primary asbestos type found in buildings (data summarized by Langer at the Harvard Symposium) and fibres > 5 microns are rarely found. In the EPA study of 387 samples, only 11 samples showed fibres, either in clumps or individual fibres, of > 5 microns in length.

Lastly, the airborne fibre concentrations in buildings are magnitudes lower than past levels in the workplace. We suggest that low level asbestos exposure of the type encountered by occupants of the building and by children in schools does not appear to present a major health threat.

Lillian Vine

Last October, the Canadian Centre for Occupational Health and Safety held a workshop on Man-Made Mineral Fibres. When I met with its planning committee, I was told the person we must have as a speaker was Bette Meek. Bette agreed, and she was a presenter and a

participant in the workshop. In April, when I met in Montreal with the planning committee for this workshop, I again heard that the person who should be speaking was Bette Meek and again Bette agreed. I am very grateful.

Bette Meek is Head, Priority Substances Section, Environmental Health Directorate for Health and Welfare Canada. She graduated with an Honours Bachelor of Science degree in Biology from Queen's University in Kingston and a Master of Science degree in Toxicology with Distinction from the University of Surrey in the UK.

Her responsibilities involve hazard and risk assessment for chemical contaminants in the occupational and general environments. Her specific interest is in the health effects of fibrous materials, such as asbestos and man-made mineral fibres; she has published several articles in this area and has acted as temporary advisor to the World Health Organization, the Organization for Economic Cooperation and Development and the International Labour Organization.

Bette Meek

It is a pleasure to be here to address a subject which presents an interesting case study in the interface between science, public policy and public perception; namely, asbestos in buildings. I would like to restrict my presentation to the available scientific data base on health risks associated with exposure to asbestos in public buildings as a basis for making public policy decisions. As you are all well aware, this is an area of some controversy. There has been, for example, considerable reaction in the United States to the excellent article on asbestos in buildings published recently by Dr Mossman and her colleagues in the journal Science. This reaction seems quite surprising in view of similar conclusions concerning health risks associated with asbestos in buildings reached previously by a Royal Commission in Ontario and several expert groups convened by international organizations.

The Royal Commission on Matters of Health and Safety Arising from the Use of Asbestos in Ontario was an independent advisory body created by the Minister of Labour in Ontario in the early 1980s. It was composed of three distinguished scientists, none of whom had any connection with the asbestos industry; the report of the Commission, in three volumes and over 900 pages, was published in May 1984. A very large portion of one of these volumes was directed towards the problem we are discussing today, namely asbestos in buildings. Although it is now several years out of date, the Royal Commission Report still provides one of the most extensive analyses of the problem of asbestos in buildings which has ever been conducted.

The International Program on Chemical Safety (IPCS) is jointly sponsored by the United Nations Environment Program, the International Labour Organization, and the World Health Organization. In 1985 the IPCS convened a task group of experts to finalize an environmental health criteria document on asbestos and to evaluate the risks associated with asbestos both in the occupational and general environments. That document was published in 1986.

Another task group of experts convened by the IPCS met in Rome in December 1988; they addressed the reduction of asbestos in the environment. They made practical recommendations to reduce risk associated with the presence of asbestos in the general environment including buildings.

A recent meeting of experts from North America, including Canada, and Europe met in Kingston, Ontario in July 1990. This was a meeting in a continuing series convened by the European office of the World Health Organization. At these meetings data on sources, concentrations, health risk and risk reduction strategies have been addressed for various pollutants of indoor air. The subject of this meeting was mineral fibres. The document from this meeting is not yet published but should be available shortly.

I would like to address the conclusions of these groups, in several of which I was fortunate to be a member, as follows. First of all is the definition of the problem, that is, the nature of asbestos-containing construction materials in public buildings. Since health risk is a function of inhalation of emitted fibres and not simply the presence of these materials in buildings, what are the airborne concentrations of asbestos in buildings? I would like to then address what we know about health risks at low levels and precautionary measures to reduce exposure. And following Dr Perrault's presentation, perhaps I'll say a few words about the health aspects of fibrous materials that are being used as replacements for asbestos in buildings.

The principal types of asbestos-containing materials which have been used in construction fall into two categories. Much of the asbestos used in the construction industry is present in hard materials such as asbestos cement building products, fire-resistant insulating boards, asbestos-reinforced thermosetting plastics and vinyl asbestos floor tiles and sheets. Under conditions of normal use, asbestos fibres are not expected to be released from these construction materials since the fibres are firmly embedded in a solid matrix. The presence in buildings of these hard asbestos-containing materials is not expected to present a significant risk to public health. Concentrations of asbestos may, however, be significantly elevated during disturbance of the material, for example during sanding, cutting, drilling or sawing, and precautions should be taken to reduce exposure during these operations.

Fibres are, however, more readily released from crumbly or friable surfaces of sprayed or trowel-applied asbestos-containing insulation. Sprayed materials containing 5% to 90% asbestos, in Canada predominantly chrysotile, were used between 1946 and 1973 on structural surfaces in public buildings to retard collapse during fire and to overhead surfaces for purposes of acoustic and thermal insulation, decoration, and condensation control. It has been estimated that fewer than 10% of non-residential multi-storey buildings in Ontario contain sprayed asbestos-containing insulation.

Pre-formed thermal insulating sections or slabs containing 15% to 80% predominantly chrysotile asbestos by weight were also used for insulating or lagging pipes, boilers, and furnaces from the mid-1920s to 1972. Although structurally solid, once the insulation is installed, the heat from the pipe or boiler causes it to become increasingly fragile and more crumbly over time. It has been estimated that fewer than 20% of non-residential multi-storey buildings in Ontario have extensive asbestos-containing pipe and boiler insulation.

When assessing health risks, it is very important to examine the available data on airborne asbestos concentrations in buildings since risk is related to emission of fibres from friable materials and not merely to their presence. The World Health Organization Working Group which met in Kingston concluded that asbestos in buildings should be measured by transmission electron microscopy and that fibre counts should be restricted to those longer than 5 micrometers, since these are the ones of concern with respect to

health effects. The available data on concentrations of asbestos measured by these methods in the air of public buildings which have friable asbestos-containing materials were reviewed by the working group. Many of the measurements in available studies represented worst-case situations, such as rooms with the largest surface areas of exposed and/or damaged friable asbestos-containing materials. But even in these cases, concentrations in surveys reviewed by the working group ranged from 10^{-5} to 10^{-3} fibres greater than 5 microns in length per cubic centimeter. These concentrations are not greater than those in outside air. Bear in mind that asbestos is widely distributed throughout the earth's crust, and is, therefore, present in ambient air or outdoor air as a result of emission from both natural and man-made sources.

Available data do confirm that concentrations of asbestos are elevated for workers who disturb the material during asbestos removal, enclosure or encapsulation, or renovation or maintenance work. Exposures may range from 10^{-1} per cc for work that minimally disturbs the asbestos-containing material to concentrations which exceed occupational limits during asbestos removal work that is not properly controlled (1 to 10 fibres per cc).

The health effects which have resulted from past high occupational exposures to asbestos included asbestosis, lung cancer and mesothelioma. In general it is agreed that asbestosis is not of concern with respect to building occupants. However, and as concluded by the World Health Organization Working Group on Inorganic Fibres which met recently in Kingston, it may be of concern for maintenance workers and others who actively disturb asbestos in buildings.

There are no reliable epidemiological studies of the occurrence of lung cancer and mesothelioma in populations exposed to the low concentrations of asbestos present in the air of buildings. Assessment of the risk of these diseases is therefore based on extrapolation from observations in populations of workers exposed in the past to concentrations up to 10,000 times as great. For this purpose, the dose response relationship is conservatively estimated to be linear. This assumption prudently implies that there is no threshold for response and that any exposure above background causes an incremental risk.

There are many uncertainties in estimates of risk derived in this manner. For lung cancer, in studies for which individual exposure estimates are available for the same fibre type, for example chrysotile, there is considerable variation in the risk of lung cancer in different industries. Risks for workers in the textile industry are approximately 50 times greater than those in miners for the same cumulative lifetime exposure. The reasons for such differences are not clear. They may be related to variations in the fibre size distribution in the different industries. Often, to provide an upper limit of the risks, lung cancer risks in the general population are estimated based on those observed in the chrysotile-exposed group for which the risks have been greatest (i.e. textile workers). In addition, for most of the studies of occupational populations which serve as the basis for the prediction of lung cancer in the general environment, the exposure estimates are very uncertain since they are based on conversion of particle counts measured by currently outdated methods to fibre counts longer than 5 micrometers measured by optical microscopy.

For mesothelioma, the model for extrapolation for estimation of risk in the general population is based both on time since first exposure and cumulative exposure. There are, however, few studies of occupationally exposed populations in which both of these

parameters have been considered. Similar to the limitations mentioned for lung cancer, for most of the studies of workers which serve as the basis for prediction of mesothelioma in the general population, the exposure estimates are very uncertain. The exposure is related to optical microscopic counts which don't include very narrow fibres, those believed to be most potent in induction of mesothelioma.

Possibly the greatest limitation of the model for prediction for mesothelioma risks in the general population is that it does not adequately take into account variations in the potency of different types of asbestos. Available data indicate that chrysotile is considerably less potent than the amphiboles in the induction of mesothelioma. The model is likely, therefore, to overestimate mesothelioma risk in occupants of buildings which contain principally chrysotile since it is based largely on studies in populations exposed occupationally to amphiboles or mixed fibre types.

Although the estimates of the risks of lung cancer and mesothelioma in occupants of asbestos-containing buildings are uncertain, they are based on quite conservative assumptions and probably provide an upper-bound limit on the magnitude of the risk. This upper-bound limit can be compared to other risks commonly encountered in society for purposes of establishing priorities in health protection.

The Ontario Royal Commission estimated that the risks due to asbestos in public buildings are several orders of magnitude below those for most accidental causes and much less than those due to common diseases. It was further estimated that the risk of working in a building with friable asbestos-containing surfaces is about 1/50 as great as that of commuting by car to and from those buildings. Doll and Peto estimated that the risk associated with exposure to asbestos in the air of public buildings is about 100 times less than that from exposure to side-stream smoke.

With respect to occupants and workers in buildings with friable asbestos-containing materials, the Ontario Royal Commission on Asbestos drew the following conclusions:

* Asbestos in buildings does not pose a significant problem for the general occupants of the building except when the occupant is in the immediate vicinity of work that disturbs friable asbestos-containing material, the occupant is within the range of air circulation of work that disturbs the material or that significant quantities of friable asbestos-containing material have fallen onto building surfaces and are being disturbed.

* Friable asbestos-containing materials in buildings may, however, present a problem for building maintenance, renovation, construction and demolition workers in the absence of precautionary measures to reduce exposure.

The Commission recommended, therefore, that there be inspection for the presence of asbestos in friable materials prior to any work that may disturb the material and that most remedial measures be performed prior to demolition, major renovation, or major maintenance of a building. For minor renovation or maintenance, the Commission concluded that the application of safe work practices would be sufficient to protect workers from excessive exposures.

With respect to management and remedial measures for friable asbestos-containing materials in buildings, the International Program on Chemical Safety Work Group on Reduction of Asbestos in the Environment felt that it was important to follow a logical,

systematic approach. The working group emphasized preventive management programs for asbestos-containing materials in good condition which included record keeping of their location, labelling of those materials which may be disturbed, public education, periodic re-inspection and minor repairs. The working group felt strongly that removal of friable asbestos-containing materials should be considered only as a last resort based on considerations of costs, the possibility that removal may pose a risk to public health if it is not carried out properly, and that workers may be exposed to elevated airborne levels of asbestos during the operation.

The working group also recommended that in any given situation priority should be given to the control of air pollution by amphibole asbestos fibres. This is based on the observation that disturbing sprayed asbestos-containing insulation generates greater airborne fibre concentrations if the asbestos is crocidolite or amosite than if it is chrysotile and due to the greater potency of amphiboles in the induction of mesothelioma compared to chrysotile. The working group further concluded that management or remedial measures for non-friable asbestos-containing material (i.e. the hard material such as asbestos cement products) is not normally necessary.

In summary, asbestos in buildings does not present a significant risk to occupants but may present a problem for maintenance, renovation, construction or demolition workers in the absence of precautionary measures to reduce exposure such as those specified in safe work practices. With respect to risk reduction strategies for friable asbestos-containing materials in buildings, management of the material in place is the most desirable option. Removal should be considered only as a last resort where it can be firmly established that the health risk is unacceptable or cannot be reduced sufficiently by other means.

QUESTIONS AND DISCUSSION

Lillian Vine

Questions, discussion? I would ask that you go to a microphone please and introduce yourself before asking your question.

Charles Prévost - Confederation of National Trade Unions

In the two presentations we had an evaluation of a threshold level at which asbestos produces effects; in the last presentation, the idea seemed to be rather that there was no safe level. I would like to have more information on what Dr. Mossman based herself on to say there was a level below which there was no danger.

Brooke Mossman

My statement was that there was a threshold with regard to asbestosis and that has been demonstrated both experimentally and in the workplace. I believe it was the conclusion of the Ontario Royal Commission that this threshold was somewhere in the neighbourhood of 25 fibre years of exposure. With regard to lung cancer, the point I wanted to make was that the overwhelming cause in most of the lung cancers is smoking. As far as a threshold per se, I don't think we can demonstrate that in the epidemiologic studies.

The only thing we can say is that some of the studies since 1970 in certain groups of workers (i.e. the British studies on friction manufacturing) show that these individuals have not developed disease at levels which are higher than those in buildings or schools.

The work by Churg has shown that in the Thetford area, despite the fact that the people are exposed to levels of asbestos 200 to 500 times higher than levels in most urban cities, there is not an increased incidence of lung cancer.

With regard to mesothelioma, we really cannot say that there is a threshold based on the epidemiologic data. However, there is a recent review which was presented at a NATO conference held in Sherbrooke in 1988 on the effects of mineral dust on cells; there is a review of studies in animals where there are levels below which mesotheliomas do not develop in either inhalation studies or injection studies.

When we talk about thresholds we have to consider the different diseases.

Pierre Girgis - Girgis Environmental Consultants Inc

The results we saw about the asbestos concentration in buildings and in the outside environment, were the tests made with the same monitoring technique?

Bette Meek

Those data were collected by transmission electron microscopy using direct sampling for fibres longer than 5 micrometers. The reason that the concentrations in ambient air appeared a little high was the limit of sensitivity at the time those measurements were conducted. In the more recent studies, there really seems to be no difference between the concentrations in ambient or indoor air. The working group in Kingston felt that direct sample preparation methods were most appropriate because you don't disturb the fibre distribution.

Pierre Girgis

In your presentation, we heard about the length of the fibre, but we didn't hear much about the thickness of fibres.

Brooke Mossman

The experimental work has found that the long, thin fibres, those with the greatest length to diameter ratios, are those which are most apt to cause mesothelioma. Most of this work was done several years ago by an individual at the National Cancer Institute who actually injected fibres directly into the pleural cavity of the animals and found that those with the greatest propensity to cause disease were those with a greater than 8 micron length and a less than 0.25 micron diameter. One sees a gradient of effect from that point out.

Bette Meek

There was a great deal of discussion at the Kingston meeting about whether we could define fibre sizes that were most critical in terms of their diameter with respect to lung cancer and mesothelioma. We think the slightly wider fibres are most important in

inducing lung cancer and the finer fibres for mesothelioma, but I don't think anyone is really prepared to say that it is a cutoff. It is probably a continuum of risk. As you increase the fibre diameter you decrease the risk for mesothelioma.

Robert Bouchard - Quebec Federation of Labour

My question is addressed mainly to Ms. Meek. We were told that the percentage of chrysotile contained in flocked material applied to the inner surfaces of buildings varies between 5 and 90%. Do you have any further information? I worked in industry as a union advisor in the area of Montréal in particular and in the Eastern Townships. We know that up to about 1973 Montréal producers of asbestos materials were selling something known as "limpet." This material was flocked onto surfaces that needed to be insulated for fire protection, including the steel structures in concrete buildings. These materials obviously become friable. Based on the reports we received from workers in industry, there was an enormous amount of amosite, that is of amphibole fibers, in these materials sold in Canada for flocking.

Bette Meek

The information that I have came largely from the Royal Commission Report in which it was reported that chrysotile had been used most extensively in insulating buildings in Canada.

Peter Gill - Region of Waterloo

The opinion is that men over 65 years of age seem to be more prone to cancer. Would that be because they had been exposed at an earlier age or because as the system slows down they are more susceptible to asbestos in the environment?

Bette Meek

It reflects that the latency period, the time of development of mesothelioma from first exposure, is 35 to 40 years; these older individuals have had the time to develop it. The increase reflects individuals who were exposed 40 years prior to the 1980s when levels were very high in the workplace.

Richard Boehnke - City of Toronto

I realize that this question is going to be difficult, but most of them are in this field. In general parlance we use terms like "low level," "moderate," and "high level." It would be useful for us to have some guidance as to what those terms mean in numbers, because it is a continual problem in dealing with the community and their environmental concerns. Could you speculate upon useful numbers for each of those categories?

Bette Meek

Does your question relate to the general environment or to the occupational environment?

Richard Boehnke

In particular to the general environment and to the non-occupational circumstances--residential and school situations.

Bette Meek

It is extremely difficult to assess what is low, moderate, and high in the general environment because in large measure the concentrations are all extremely low. When you compare these concentrations to the sort of past airborne concentrations in the occupational environment with which there was increased risk, you are talking 1,000 to 10,000 times lower. We are having difficulty measuring the concentrations that are present in the general environment; it would be extremely difficult to try to categorize them.

Brooke Mossman

I agree entirely. You cannot put numbers on them. You can put a range of numbers--the occupational might be 1 fibre/cc or higher whereas the levels in buildings, 1,000, 10,000, 1,000,000 times lower than that.

Scott Houston - The Asbestos Institute

You made reference to certain studies done recently in the United Kingdom on chrysotile asbestos workers where there was no excess disease among them. Do we have indications of the exposure levels for those workers?

Brooke Mossman

One of those studies was a follow-up study comparing the disease in workers, pre-occupational standard versus post-occupational standard. I believe the occupational standard in England around 1970 was 2 fibres/cc. When I say "low" it is lower than levels that caused disease in the past, but it is high in comparison to what we are seeing now in buildings and schools.

Lillian Vine

Dr Don Pinchin's formal education includes a Bachelor of Science degree in Physics and Chemistry and a Master of Science degree in Chemical Engineering from the University of Toronto followed by a doctorate in Physics from Cambridge University, England. His research interest at university centred on fibre-reinforced cement, an interest which continued at the Ontario Research Foundation where asbestos was treated both as a useful reinforcing fibre and as an environmental and occupational problem.

With the realization in Canada of the scale of the potential problems posed by friable asbestos in buildings, Dr Pinchin established, in early 1980, a three-day training course on asbestos control for contractors, building owners, and government officials at the Ontario Research Foundation. Since then he has presented this course to over 3,000 Canadians including virtually all of the contractors and consultants working on the asbestos issue in Canada. In 1981 he established his own firm and continued to present these training courses. Pinchin & Associates Ltd operates from offices in Mississauga, Montreal, Toronto, Ottawa, Quebec City, Kitchener, London, Winnipeg, Sarnia, and Halifax. An associated firm operates from ten permanent offices in Western Canada and the Northwestern United States. The firm covers all aspects of asbestos control: hazard evaluation, product testing, consulting and architectural aspects, air monitoring, and education of maintenance personnel, contractors and owners.

One of Dr Pinchin's main accomplishments has been the report "Asbestos in Buildings" produced for the Royal Commission on Matters of Health and Safety Arising from the Use of Asbestos in Ontario. This report covered all aspects of asbestos in Ontario buildings and formed a main part of the final Commission report. This report has had a major influence on current asbestos legislation in Canada.

Dr Pinchin was a keynote speaker at the first National Asbestos Council meeting in Atlanta, Georgia. He is the author of numerous papers and presentations on asbestos in buildings and asbestos control measures. He has also presented expert testimony before the US Environmental Protection Agency and for asbestos related litigation. He is a Director of The Canadian Chapter of the National Asbestos Council.

Don Pinchin

When we talk about asbestos in buildings, what should we be talking about? The answer is that we should be discussing only the problem of friable asbestos in buildings. A friable material is a material that can be crumbled or pulverized to a powder by simple hand pressure. There are many different ways friable asbestos can be applied. Spraying is one method of installation. When a sprayed product is installed the term "friable" would clearly apply. One misconception is that even though there may only be 10% to 15% of buildings which have been sprayed, when you find one that has been sprayed for fireproofing, it is usually totally sprayed because of the construction method used.

There is another misconception with respect to the Canadian situation. The presence of sprayed crocidolite and sprayed amosite (blue and brown asbestos) in Canada is much more general than in the United States. This had to do with trade and market conditions. There is a significantly higher percentage of amphiboles used in Canada even though Canada produced chrysotile. The sprayed chrysotile in appearance is not remarkably different although it is more easily identified by eye as a much whiter material.

Another type of sprayed product normally used for fireproofing is mudlike in appearance. The most common material was sold under the name "Monokote MK III." In more general use in the United States than in Canada is a sprayed or spackled texture coat applied for decorative or acoustic purposes in schools, public buildings, hotels and even some homes.

The other main class of friable material is that used in mechanical insulations. Even though one can say most asbestos used in mechanical insulation was chrysotile, there are many products in which a high concentration of amphiboles is present. Although chrysotile is in the vast majority, the brown and the blue asbestos materials (amphiboles) are quite common.

What are we <u>not</u> talking about in asbestos control? We are generally not talking about the harder, non-friable materials such as floor tiles, transite sheeting, most of the gasketing materials, and friction products.

Why are we concerned about any of these products? Basically, we should be talking about the products because of the health effects and the fact that you cannot see the airborne asbestos fibres so the identification of a potentially hazardous condition is not obvious.

Is asbestos in a friable form hazardous in a building? This question was extremely valid in 1981. I really believe I was satisfied by the answer that the Ontario Royal Commission gave in 1983. Some of its conclusions are very important although I think I have a slightly different approach than was given in the previous presentations. From the final report of that Royal Commission, Page 548, "...in dramatic contrast [to the workers who applied the material] the exposure of building occupants to asbestos fibres during normal building use will be shown to be insignificant." That is a very clear conclusion for a Royal Commission. "We [the Commissioners] will conclude that it is rarely necessary to take corrective action in buildings containing insulation to protect the general occupants of those buildings." Both of these statements are quite in line with what we have heard earlier today.

That is the good news. However, on the same page, the Commission states "...on the other hand, construction, demolition, renovation, maintenance and custodial workers in asbestos-containing buildings may be exposed to significant asbestos fibre levels [levels that have been shown in the past to produce an asbestos-related disease] and may, during their work, cause elevated fibre levels for nearby occupants." The Royal Commission made a very strong statement that the protection of these workers and not the protection of building occupants should be the thrust of an asbestos control program and is the main problem in maintaining safety of asbestos in buildings. This message was, until recently, ignored in the United States where removal, in many cases, was being undertaken for removal's sake. I do not believe that has been the case in Canada, although it has been to some extent. It is important to realize that the paper and scientific battle going on in the US pits Americans against Americans, instead of Americans against Canadians. The view that is now coming out of the Harvard Studies seems to be rolling back towards the Royal Commission conclusions. Unfortunately in the Harvard paper there is an underemphasis on normal activities of a building. Buildings are not static things; buildings are renovated and maintained on a daily basis and the protection of these workers has been overlooked.

What are your options? If you decide that some sort of action is necessary, then you are into the open arms of the asbestos-abatement industry. Whether that abatement is removal, enclosure or encapsulation is your choice. Only removal provides a permanent solution. Enclosure may be very useful for the repair of damaged mechanical or pipe insulation. Encapsulation is, with good justification, rarely recommended. It is the spray application of a paint-like surface onto sprayed asbestos. It is a short-term, expensive and not very useful solution. The final option that everyone must consider is that once you are aware of the presence of asbestos, to prevent it from becoming airborne you must have a management program. Asbestos undisturbed is not a problem; however, unless you have a management program, it will be disturbed.

On the basis of the Royal Commission report in 1983, the Ontario government came out with Regulation 654/85 in the late 1980s. This has been copied, parallelled, paraphrased and improved on in most Canadian provinces. It applied to construction projects; it applied to buildings that contained asbestos insulation or fireproofing; it applied to maintenance or repair work in the building; it applied to demolition of machinery, equipment, ships and vehicles; and it applied to maintenance or repair work on machinery, equipment, ships and vehicles. This Regulation crossed the normal barrier between construction and building operation; it tried to draw them together and that is one of the reasons its enforcement has been spotty at best. It lays down a number of duties and most Canadian Regulations lay down similar duties. An owner must have a management program. To put a management program into effect, s/he must prepare and maintain a

record of the location. You cannot manage something if you don't know where it is; this is one of the serious drawbacks of the recent Quebec Regulation--there is no mandatory survey required. All of the enforcement seems to be put onto the constructor who arrives on site or to the maintenance worker who works with it. If you don't have a survey, how do you know where it is?

You must notify workers who might disturb it. You must provide training on asbestos. You must, by some periodic inspection of the asbestos, make sure your program is working. You must take remedial action on deteriorated material.

Once you get into the construction operation and the tendering of work, there is a mandatory inspection for asbestos and you must prepare a report to prospective constructors and provide them with the report. In these cases, there is a requirement for a survey.

I am very briefly going to mention the components of the management program because there are provincial differences. I will refer mainly to the Ontario regulation. There must be a detailed survey that identifies the type of asbestos; that survey must be available in the building at a central location; it must identify the number of employees potentially exposed; and it must identify the friable materials. There is no mandatory survey for non-friable materials. There must be regular re-inspection and this is where it becomes difficult to enforce this Regulation. In the five years since the Regulation has been passed, it is my estimation that approximately 25% of the buildings have been surveyed. How are we going to re-inspect at least annually? There must be written documentation of worker training--this is where there is a great deal of work to be done by the unions and by management. The training must be on the hazards of asbestos, the use, care, and disposal of protective equipment and the fitting and maintenance of a respirator with mandatory fit testing. There must be a list of the persons trained and the date of training; the types of operations, work practices, procedures and the personal protective equipment that is appropriate; and written standard operating procedures. (I would be surprised if there were more than one or two contractors in Ontario who could actually do that. They just cannot do it--the turnover is phenomenal on these projects. I think the turnover is phenomenal because the pay is low and the working conditions are awful.)

There must be notification to workers and contractors of work in the area where friable materials are present. There must be directions to ensure deteriorating material which will continue to deteriorate and which may cause exposure will be repaired, sealed, permanently enclosed or removed. This is where we are attempting to clean up the damage of the past.

If they find unexpected friable materials, the contractors are required by law to stop work, collect bulk samples, determine if there is asbestos present or proceed with the work assuming an amphibole asbestos is present. This gives a great deal of power to a contractor.

Canadian Regulations are regulations by procedures. These are operations which have been established based on the airborne fibre levels that they may generate. A low risk operation has a low corresponding health risk of elevated fibres--working with non-friable materials. A moderate risk operation would have a moderate health

risk--minor disturbance of friable materials. A high risk operation has a high risk of airborne asbestos and correspondingly a high health risk--major demolition or removal projects.

One important question is why are asbestos control and management programs difficult to make work? Why are the people in the industry somewhat pessimistic about how well they are working? The first thing is how difficult they are to comply with and how difficult they are to enforce. In some buildings, there have been incidents where asbestos has previously fallen down onto drop ceilings and in these situations it is very difficult to manage the asbestos. You cannot stop entry to the ceiling and every time a tile is lifted, the asbestos may fall out. In demolition work the fact that asbestos has been handled traditionally by just pitching it out onto a scrap heap makes it difficult to manage and re-educate workers. When you have a large industrial facility, such as a refinery that has 10 to 15 miles of piping with asbestos insulation, how are you going to manage it when every one of your workers potentially may be damaging this material? When every bit of work that affects your mechanical system or your ceiling may disturb it? These situations are not theoretical, these are facts and they are facts that building maintenance programs have to address. It is not sufficient to say, "We should be very cautious of proceeding with removal because we know that removal is dangerous." It is dangerous, but leaving material in the building is or can also be dangerous if the management program does not protect the maintenance and renovation worker.

I don't mean to imply that only the maintenance of material in a building is potentially dangerous; asbestos removal is also potentially a serious problem due to staff turnover and the lack of training--it is awful work; I wouldn't want to do it. Frequently the owner doesn't want to know what is happening; he doesn't understand why when he leaves the school in the spring and comes back to it in the fall after spending $10 a square foot, the school looks the same as it did when he left. The low-bid situation which school boards and public owners have to face makes for a terrible problem. The competitive pressures, not just from inside the asbestos removal industry, but from outside it, such as demolition contractors who switch to asbestos removal because demolition work is slow. The lack of any certification program whatsoever in Canada is a problem. Anyone, with no requirements whatsoever, can become an asbestos contractor--the Regulations require training but it is not adequately enforced in any province except British Columbia.

I would like to leave with you an idea which I hope you will take with you to the discussion groups. In a workshop like this there may be several constituent groups which I don't believe are well represented here. Think about those constituents. Firstly, the "non-professionals." The public does not realize and is not able to put a yardstick on the actual risks; people have heard so much about risks, they do not know who to believe. The second group--by far the most important group that may be under-represented--are those persons who look at asbestos disease and say, "We know that the past history of maintenance of asbestos in buildings shows it has caused disease and death in workers; we are not prepared to accept for our union members or for the people who occupy the buildings that this is a reasonable risk to take in the future because we know that asbestos management won't and doesn't work." Experience is going to show that lack of risk for building occupants may not be reflected in a lack of risk for building maintenance workers if the management program doesn't work. This is a view that has to be addressed and that is critical in the evaluation of the conclusions of this workshop.

PERSPECTIVES:

BUILDING OWNER PERSPECTIVE
Melanie Stoughton
Scarborough Board of Education

LABOUR PERSPECTIVE
Serge Trudel
Quebec Federation of Labour

OTHER MINERAL FIBRES

Guy Perrault, Institute de recherche
en santé et en sécurité du travail

CCOHS/CCHST

Lillian Vine

Our Planning Committee wanted to present the asbestos program of a big organization with special responsibilities. A large school board appeared to be ideal with its numerous buildings, different types of workers, and the most vulnerable of populations--children. We looked for a program that was functioning well. Melanie Stoughton will speak to us about the program of the Scarborough school board.

Melanie Stoughton received her undergraduate degree in Human Physiology from the University of Toronto and her Master's degree in Occupational Hygiene from the Department of Community Health, Faculty of Medicine, University of Toronto. As part of her Master's degree, she spent one summer working for Ontario Hydro in the Industrial Hygiene Section of the Safety Services department and worked part-time at Imperial Oil writing their in-house MSDS.

She received her certification as an Industrial Hygienist in Training; her first full-time job as an Industrial Hygienist was with Petro-Canada, where she had the responsibility for two Ontario refineries and the other Ontario operations. This included sampling for all manner of hydrocarbons and assessing asbestos both on refinery lines and in non-refinery buildings.

She started with the Scarborough Board of Education in January 1989 where, as the Occupational Health and Safety Advisor, she is the entire Occupational Health and Safety and Environment Division.

Since she has been with the Board, Melanie says she has learned to both loathe asbestos for the aggravation that it causes and to love it because her job with the Board is secure. She also has the dubious honour of being one of the "stars" of the Ministry of Labour's "Asbestos in School Buildings" video.

Melanie Stoughton

I would like to talk to you today about asbestos in public buildings or How I Fought the "A-Word" and the "A-Word" Won! Most of us who work in the public sector, particularly in school boards, have come to regard asbestos as a dirty word.

Scarborough is one of six cities--York, Toronto, Scarborough, Etobicoke, North York and East York--that make up the region of Metropolitan Toronto; each of these cities has its own school board and the Metro Toronto School Board (MTSB) acts as a coordinating body. The MTSB divides all the tax monies and approves our large capital projects. The Metropolitan Separate School Board is the Catholic Board for the Metro Region.

The Scarborough Board of Education is the seventh largest school board in Canada; we have 8,000 full-time employees, five unions; three teachers' federations and two CUPE locals, two non-teaching non-CUPE staff associations, and two associations for principals. All

of these organizations are represented on two separate health and safety committees--the Joint Health and Safety Committee for our CUPE staff and the Educational Environment Joint Health and Safety Committee representing our teaching staff.

The Plant Department of the Board has the responsibility for the cleaning and maintenance of 168 sites, consisting of 25 secondary schools, 135 elementary schools and 5 administration buildings for a total of 10.5 million square feet; 90% of those sites were built before 1980 and contain friable asbestos. Over the past 10 years we have spent approximately $15 million removing asbestos from our schools.

The Plant department has two staff members who have primary responsibility for managing asbestos--me and our Chief Supervisor of Maintenance. I am responsible for program coordination--supervising the paper work, setting the general program, advising staff, training and ensuring the correct information is in the right place at the right time. Our Chief Supervisor of Maintenance is primarily responsible for emergency repair/removal of asbestos-containing materials and for our large-scale planned removal. He also has the difficult responsibility of hiring and supervising our abatement contractors. This year we have spent approximately $2.5 million as part of our renovation program.

One thing about school boards that you must keep in mind is that we don't have shareholders, we are not profit driven. We are allowed to go into debt every year if we need to. We are concerned with education and we are encouraged to do everything we can to further children's education.

The issue of asbestos in Ontario schools started in the late '70s around the time of a high level of public awareness and the start of the Royal Commission. Initially, the focus was on only friable sprayed-on fireproofing and acoustic insulations. The Ministry of Education in Ontario provided funding for the school boards to deal with this. The boards had options; they could choose to enclose, encapsulate or remove. In 1980, the Scarborough Board of Education encapsulated a couple of schools and found it to be unsatisfactory. The Board then started to remove asbestos instead.

The funds continued until about 1985 when the Ministry of Education decided that asbestos wasn't a problem any more. After that, no monies were approved for asbestos removal. At no time did the Ministry of Education express an interest in friable asbestos as mechanical insulation; it was virtually ignored until about 1989. The Scarborough Board of Education took money from its maintenance funds to allow us to remove asbestos from boiler rooms. When the funding dried up in 1985 we continued the boiler room abatement program because a boiler room is a small project. We were, however, unable to finish two large full-scale projects of removing sprayed-on fireproofing.

Funding did not begin again until the summer of 1989. In 1989, the Scarborough Board of Education was the only one in Ontario to actually get monies for asbestos removal.

A controversy started in Hamilton schools in the summer of 1989. I understand that the Hamilton Board had a lot of schools where asbestos which had been encapsulated 10 years

ago was in bad shape. Those of us at Metro School Boards smugly congratulated ourselves for having avoided this type of problem. Little did we realize what was coming our way in December.

In December 1989 the Toronto Star published two front-page articles--one about the Board of Education for the City of Toronto and one about the Scarborough Board of Education. The Toronto article was about a caretaker at a secondary school who had died from mesothelioma. Pictures of large chunks of pipe insulation sitting on the floor of the boiler room caused the Toronto Board of Education to substantially revise what it was doing. The caretaker's family received a pension for his mesothelioma.

The article about us was based on Ministry of Labour documents found in Ministry of Labour files on our board. The article said that according to one document we had failed significantly in a number of areas. This document was actually a critique of the first draft of our asbestos management program. The hygienist at the Ministry who wrote this critique made it a very technical document; all you could really understand was that the program was insufficient and that we would have to do more work. For us the furor died very quickly because the Ministry of Labour went on record saying that we were the only Board in Ontario in compliance with relevant legislation. In January, the Ministry of Labour investigated all six school boards in the Metro area and gave a March 1990 deadline to have asbestos management programs in place and surveys complete for all the Metro schools--that is 600 schools in two months. All the other Boards in Ontario were given a May 1990 deadline. I don't know how many of the other Boards have managed to meet that deadline--I do know that Hamilton has.

For us, this media attention led to phone calls from concerned parents. We spent a lot of time on the phone carefully talking about the problem. In February, the problems with the Metro Separate School Board started to appear. Stan Gray was hired by the teachers' association to look at some problems there. At least 5 of 200 schools was found to have asbestos problems; another school had some indoor air quality problems. Nightly, there was news coverage of meetings showing Metro Separate School Board officials and parents yelling at one another.

Our problems didn't start until April 1990 with the great "Transite Panel Fiasco." We have an old school, Birch Cliff Public School, which was built in 1924 and is in a section of town where the parents are environmentally conscious. Had any of the problems that occurred at Birch Cliff occurred singly, we wouldn't have had any problems. But they all occurred together and it became a two-month migraine for us.

We were removing exterior decorative transite panels that were installed as part of an energy efficiency campaign. They were being replaced with asbestos-free granex panels. The contractor, when asked by the principal if there was any asbestos, said that there was none in the transite panels that were being thrown from the roof into the school yard during school hours. The principal, trusting the contractor, told the community that there was no asbestos. A parent took a sample from a very messy yard and had it analyzed and it, of course, had asbestos in it. Some of the parents took their children out of school for two weeks and wouldn't let them back in until we cleaned the interior of the school. But they wouldn't allow us to clean the interior of the school until we had air sampling done to prove it was safe. After multiple parent meetings we did $20,000 worth of interior and exterior monitoring only to discover that we had ambient levels of asbestos.

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As painful as this episode was for all of us, it has not been without some very valuable lessons. We learned that it is very important to communicate fully with the community when any work is to be done on a school. We have developed form letters to be sent out by the principal to the community when asbestos removal work is to be done. We have to communicate with the community, the parent groups and the groups using the schools in the evenings. We have learned that early involvement of appropriate labour representation in events like this ensures cooperation and assistance and prevents problems. At no time were any of the unions upset by the transite; in fact, some of our tradesmen volunteered to talk to the parent groups.

The Scarborough Board of Education is unique because, back in the early '80s, it decided to remove asbestos instead of encapsulating it. Shortly after, a program to remove asbestos from boiler rooms was started. There was always an awareness of problem areas and informal but proper procedures to deal with asbestos.

In early 1987, the Ministry of Labour inspected one secondary school and found damaged pipe insulation and ordered the institution of an asbestos management program at that school. The Board, at that time, decided to institute an asbestos management program Board-wide. In consultation with the Ministry of Labour and a consultant, a program document was drafted and submitted to the Ministry in December 1987. Ten months later, after multiple requests from Board staff, the review was received by the Board. The appropriate changes were made and the document was returned to the Ministry in early 1989.

The next step was to complete surveys for friable asbestos-containing materials; this was undertaken in the summer of 1989. The reports were received in the fall of 1989 and document review was undertaken and the completed asbestos management program sent out. In January 1990, the Ministry of Labour took the asbestos management program for review and set its review in April 1990. The changes required were cosmetic only.

However, in light of our desire to provide a safe and healthy working and learning environment, we have given the program a more complete revision than required by the Ministry of Labour, incorporating the lessons we learned in May 1990. The asbestos management program will have to go back to the Ministry of Labour, but before it goes back it will have been reviewed by both health and safety committees and senior management staff.

As I describe the program to you, I would like you to keep in mind that our program is designed to meet the spirit of the law, not just the letter of the law.

At every school, there is a copy of the asbestos maintenance program which includes the general program, Section 1, and Section 2 which is the record of surveys and remedial action for asbestos taken at that school.

Section 1 deals with the generic issues of training--who will do what type of asbestos-related work, what kind of surveys will be done and when, work procedures for asbestos, communications and notification requirements, pre-qualification of asbestos abatement contractors, and the Board's philosophy on asbestos.

We have a significant training mandate. For our caretaking staff (about 800 cleaners), we are doing labour/management co-training using a Board-developed video tape and

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Board-developed work books. That program is due to start in about a month, once there has been final approval of the program by our Joint Occupational Health and Safety Committee.

For the maintenance staff, there are two levels of training. For our trades staff who are not expected to work on asbestos products there is a four-hour session on asbestos information and how to use the asbestos information that is available in our schools. For our supervisors, for our inspectors, and for trades staff who are expected to do asbestos emergency work, there is a 1-1/2 day hands-on program. The principals are being offered 1-1/2 hours of asbestos training on a voluntary basis. They are fairly enthusiastic about this program; about 3/4 of them signed up. Voluntary information sessions will be offered in January for the teaching staff. I do not expect that these will be very well subscribed.

Our work procedures for asbestos are only slightly out of the ordinary. Our Board is probably unique in Ontario in that we allow our staff to perform asbestos work only in dire emergencies; otherwise it is all done on a contract basis. Asbestos repair, removal and clean-up are all done by a contractor in a manner which gives the greatest margin of safety to the worker and the building occupants.

All other asbestos work is to be done by pre-qualified contractors in accordance with detailed project specifications. All large scale removals are accompanied by air monitoring for asbestos fibres before, during and after removal, along with regular inspections by asbestos consultants. Those consultants are given the power to stop the job if necessary.

We use state-of-the-art procedures; we don't just follow the legislation in Ontario because that legislation for high-hazard jobs is inadequate--it does not provide sufficient protection for the workers or the building occupants.

Communication is very important. For the principals we have a checklist. We have a checklist for our own staff to make sure they have told the principals everything. We have developed form letters to send out to the community to tell them what is happening--when it's going to happen, how it's going to happen and who to call for information.

Our final type of communication is a yellow sticker, new this summer, that goes on piping and any other areas where friable asbestos was removed so that the maintenance staff will have two methods of determining that an area is asbestos-free.

ASBESTOS ABATEMENT
PROGRAM 1990

In accordance with Ontario
Regulations 654/85 of the
Occupational Health and Safety Act,
asbestos-containing products have
been removed and area inspected.

Plant Department

Finally, the Board's philosophy on asbestos is that there will be a total phased removal of all asbestos-containing materials over the next 10 to 20 years. At this point there is only one site remaining with asbestos-containing sprayed-on fireproofing.

Section 2 of our program is called "Specific Program for School X" and is specific for each individual building. It will include three surveys--a survey for sprayed-on materials, a survey for asbestos in the heating, ventilating and air conditioning system, and a survey of boiler and mechanical rooms.

We made two assumptions when we made these surveys. We assumed that the piping found in the boiler room is representative of the piping found in the rest of the school. For example, if the hot water pipe in the boiler room had fibreglass on the straight runs and asbestos cement on the elbows, valves and fittings, we would assume that the hot water pipes in the rest of the school were the same.

We also do a comprehensive survey to determine the location of all asbestos-containing materials. Every summer we renovate or put additions onto 10 to 20 schools; this fall we plan to do a comprehensive survey for every possible asbestos-containing material on the interior and the exterior of the school. This will become part of the permanent record. This allows us to know the locations of all asbestos-containing material, since our eventual goal is total removal and it allows us to include the asbestos removal information in our project specifications and tender documents.

There is also a list of remedial work undertaken at the school and this list will be updated yearly.

Section 2 also contains a contractor acknowledgment form which all contractors are expected to sign after reading through the asbestos management program at the school before they begin work on the school.

It will take us 10 to 20 years to remove the majority of asbestos-containing material from Scarborough schools assuming that we continue to get funding at the same level as we are getting now. If funding diminishes, it could take 30 to 40 years.

Our plans for the asbestos management program include yearly review and revision of the general program as necessary. We will also do a yearly updating of the school-specific section and the ongoing comprehensive surveys for all asbestos-containing materials.

It is going to be a long-term battle; we have no quick answers to this problem.

QUESTIONS AND DISCUSSION

Lillian Vine

If you have a question to ask Don Pinchin or Melanie Stoughton, or a point to bring up for discussion, please go to a microphone and introduce yourself.

Marcel Cossette - Ceram-SNA Inc

Regarding the "Great Transite Fiasco," what kind of material was eventually used to replace those panels?

Melanie Stoughton

We used Granex which does not contain asbestos.

Marcel Cossette

Do you know if it contains any fibres?

Melanie Stoughton

No, I don't know what the composition is aside from its containing no asbestos.

Marcel Cossette

You are sure that it is a safe material?

Melanie Stoughton

We are as sure about that as we are about anything.

Sharon Fair - Hamilton Board of Education

Our Board receives five to ten telephone calls per day. We have 120 buildings with asbestos materials. We interact on a daily basis by computer and telephone. How do you maintain contact if you contract your work out? We have the ability in-house to respond to the very simple repairs.

Melanie Stoughton

We don't see that same level of concern; the Hamilton Board may not be representative of other school boards. We might get two calls a week.

Sharon Fair

It is actually plumbers or electricians calling us about very maintenance-oriented work; these are practical jobs, such as a plumber needing assistance to do a pipe repair job.

Melanie Stoughton

The difference between our two Boards is that asbestos responsibility--the actual repair/removal--in our Board rests with the maintenance department. Everything comes in through the maintenance department first so they will cross-reference to find out what it is and so long as it is not a crisis, they will send out job orders to our contractors. We have one firm who will do work for us on 20 minutes' notice.

Sharon Fair

Do you find that you spend a lot of money on daily repairs?

Melanie Stoughton

No, not really. We have a very good preventive maintenance with our asbestos insulation program that we have had in place for about 10 years.

Sharon Fair

My second question relates to outside contractors doing construction work. We also provide them with pre-renovation surveys which are quite extensive samplings of walls that are being demolished, pipes behind the walls, and so on. The reality of the work is such that they may tear apart some insulation which they know contains asbestos. Do you have an inspection program during construction?

Melanie Stoughton

For construction we have six staff members who inspect construction itself and any renovation work that we do in general. For any asbestos removal work we have hired consultants to inspect. The other way to deal with contractors is to pre-qualify them. Any of you who have had any experience with construction contracts and documents know that there is a form that you can use to pre-qualify your contractors and you can accept only people who meet certain criteria. It helps to reduce the problems associated with a low-bid contractor.

Enzo Mancuso - Canadian Automobile Workers' Union

Miss Stoughton, I totally agree with you that school boards in general have a problem with communication, but I want to add that when they do communicate, they either give out the wrong information or they lie. According to the article in the Toronto Star, before Stan Gray was retained by the Parent/Teacher Association, the parents were told by the principal that there was no asbestos at all in the school. Stan Gray found friable asbestos. It is easy to shoot the messenger, but the message was that the Board was lying.

You also spoke about the teachers not being interested in your courses. I might remind you that many of the teachers who exercised their right to refuse under the Labour Code were reprimanded by the school.

Richard Boehnke - City of Toronto

Miss Stoughton, you indicated that making the assumptions you did had saved you money. Why?

And how do you pre-qualify contractors?

Melanie Stoughton

By assuming the rest of the school contained the same types of materials as the boiler rooms we saved money because we didn't have to take samples throughout the school. It was strictly a business decision.

As far as pre-qualification of contractors goes, I will do something shameless and plug an article that I wrote for the next issue of OH&S Canada on that topic. Your local construction association has pre-qualification forms. You pre-qualify people on the basis of their having done similar work, having done jobs similar in cost magnitude, calling every one of their references and asking specific questions about the things that are important to you. If you are interested in maintenance of your own safety standards, ask the references if the contractor lived up to their safety policies while working on site. We require the contractor to show that the supervisors on the job have had appropriate training by producing a copy of a certificate from an asbestos course or a letter from an asbestos consultant to say they have had appropriate training and that they know what they are doing.

Pierre Girgis

Don, do you know about a good asbestos management program that is successful? You indicated that there are some problems with implementation of these programs.

Don Pinchin

I did not mean to imply that management programs don't work. Management programs dealing with mechanical insulation are significantly easier to implement because of the basic nature of the material. Generally, the management programs that work have good training of the staff. Rather than have a large group of maintenance staff doing it, they have a smaller group of specialists within that maintenance staff. It also is essential to have a survey. The programs are effective and efficient, or certainly effective, where the occupants of the buildings, even though they are not at risk, are informed of the management program so it becomes somewhat self-policing. If the maintenance staff take a sledge hammer to the pipe elbows to finish the job more quickly, one of the building occupants will notice and will report it. It must be a strongly policed system, whether by an outside consultant, the supervisors, or the occupants.

The management programs for spray are much more difficult because under what I assume to be Type 2 procedures you have to do things such as have the air off in the building. This implies night work. What happens in buildings at night is not what most people think happens in buildings at night. It is a very difficult program to enforce at night.

Under the Quebec Regulations, any manipulation or handling of amphibole materials is a Type 3 operation. This makes a management program in any building with amphibole present impossible in Quebec.

Pierre Girgis

Melanie, you said you are going to have a management program for 20 to 30 years. I see that you are only making assumptions that what is in the boiler room is in the rest of the school. Does this mean that you didn't survey or make an assessment for all asbestos-containing materials in schools? How are you going to establish priorities for the next 20 years?

Melanie Stoughton

That is where our comprehensive survey comes in. We have our schools on a 10 to 20-year cycle for a refit (renovations). For those schools that are about to undergo the refit, we do a comprehensive survey and find every last fibre.

Pierre Girgis

So it is only during renovation, not to make a priority list for every school for corrective measures!

Melanie Stoughton

We have that for our pipe insulation and we know where all of our sprayed-on fireproofing is. We have one secondary school left that contains sprayed-on asbestos fireproofing. It is going to be done next year. This summer, we finished the final school that had asbestos-containing insulation in student areas.

Pierre Girgis

So you developed an index to establishing priorities?

Melanie Stoughton

Yes, and also when we do the annual asbestos inspection we prioritize any problems we find with our mechanical insulation and deal with those on a needs basis. Anything that is badly damaged gets repaired or removed immediately; anything that is not so bad we get to in a year; and anything that is not a problem we leave alone.

Elvira DeMonte - Metropolitan Toronto Separate School Board

A statement was made that schools lie to parents. I have been on the school board for 20 years and that is not the case. That many people are not well informed is probably the basis of the problem of dealing with asbestos. We are not dealing with authorities, we are dealing with feelings and opinions (sometimes not accurate) of different people. Communication has been a problem but it has been a problem of everyone knowing that they are doing the right thing and going in the same direction.

Guy Perrault - Institut de recherche en santé et en sécurité du travail

During the removal of the asbestos in Ontario schools, are officials taking advantage of the occasion to have the concentration of asbestos in the school air checked before and after the removal?

Melanie Stouton

It is at our Board. When we do a large project which we call Type 3 projects, we will do air-monitoring before, during and after the removal. It is done inside and outside the enclosure; sometimes just outside the enclosure. While I have been with the Scarborough Board of Education I have not seen anything significant outside the enclosure.

Don Pinchin

Under the Ontario Regulation there is no mandatory air monitoring before, during or after. It is regulation by procedure entirely which says if you follow certain procedures it will be safe at the end. In virtually every case that I know of, air monitoring is done. Where any consultant is involved for the purpose of controlling or

for providing data for future occupants, the monitoring is usually by the PCM method which has known and visible limitations, although more and more of our clients are requesting the use of the electron microscope which is readily available.

Gérard Lachance - Syndicat des Métallos

My question is directed to Ms. Stoughton. First I would like to congratulate her for going beyond the law of Ontario in relation to several health and safety matters. But could you elaborate a bit on the legislative requirements and how exactly you go beyond them?

Melanie Stoughton

The law in Ontario doesn't give specific details on training, it just requires "sufficient" training on uses and hazards of asbestos. We have gone into a very specific program that has had labour approval in training our CUPE staff. The teaching federations at our Board do not seem to be as interested in their own health and safety and I don't know why. They are more interested in the children, so if we want to get their interest, we have to talk about the kids.

Our procedures for removal are state-of-the-art; they are significantly better than what the government allows. We insist on air monitoring on a large removal and negative pressure units in the enclosure.

There is no requirement to communicate with our community. We notify the tenants of our buildings but we are not required to by law.

Bill Denault - W Denault & Associates

Melanie, I wonder if your organization uses any computer-assisted design, mapping or management software to assist you in monitoring this activity?

Melanie Stoughton

Unfortunately, not yet. Our plant department, as far as maintenance activities go, is a little behind the times. We haven't even gotten the small scale drawings for our 168 sites on computer yet.

Louis Berlinguet - IRSST

If you have the figures about the airborne fibres before, during and after, what kind of results do you get?

Don Pinchin

You have to break that down into what you get by PCM and what you get by TEM. In monitoring before the work starts, assuming there is no disturbance of material, the TEM levels are typical ambient levels outdoors. In most cases they are at ambient levels. The PCM levels are rather irrelevant. During the work the levels are quite high depending on the material being dealt with. With amphiboles, they can be extremely high--20, 25, 30; if dry removal, up to 600-800 fibres/cc by PCM. With chrysotile, it

is always much lower; and with mechanical insulation, on the low side. At the completion of work there is no reason why the TEM levels are any different than at the start of work and certainly the PCM levels very often are somewhat lower or the same as outdoor levels. With negative pressure in operation you are measuring the levels of the air you are drawing in.

John Crick - Canadian Centre for Occupational Health and Safety

Don, you showed us some startling slides of people working with asbestos in a very careless manner and mentioned that the government's ability in Ontario to monitor the annual reviews of the asbestos content of buildings was very difficult. Do you think that with the implementation of Bill 208 and the Joint Health and Safety Committees that will be organized within Ontario that problem will be in some way rectified?

Don Pinchin

I don't know. I do know that there is a great increase in the number of consulting firms--some very good, some very bad. It is a case of how much effort and money is put into these surveys. I think it is extremely important for the asbestos control program to become the property of the building, physical plant and maintenance staff. A survey can be done but yearly re-evaluation of the building is, I believe, impossible. If someone disturbs the material the day after the survey is done, that shouldn't wait a year for repair; a yearly survey may not be enough. It should be looked on as part of any other health and safety program that is maintained in a building by the owner and the staff.

Henri Vuillard - The Asbestos Institute

It is not altogether true that the regulations in Canada are similar from one province to the other. There are very significant differences. This is particularly the case for planned maintenance programs known as "management programs." Only in Ontario and Nova Scotia do the regulations require building owners to maintain the asbestos-containing materials on their buildings. This is one of the reasons why we no longer have management programs.

Lillian Vine

We would like to show you the CCINFOdisc electronic system of CCOHS. Unfortunately, there was a delay. Trillium Computers, to whom we are very grateful, are lending us their equipment and sent it Friday; but it has only now arrived. You can now see it during the coffee break and after the afternoon session today.

Our next speaker is Serge Trudel. Serge is the Director of Occupational Health and Safety Services at the Québec Federation of Labour. He is a member of the department of occupational health and safety and is responsible for WHMIS.

Serge was a union representative for eight years for the Steelworkers' unions where he was in charge of occupational health and safety alternately in Québec and for all of Canada. For two years he was a research consultant at the Institut de recherche en santé et en sécurité du travail where he concentrated particularly on the analysis of work accidents. He worked in a foundry, La Forge CSW, for six years.

Serge is a Governor of the Council of Governors of the Canadian Centre for Occupational Health and Safety. He is on the IRSST Scientific Council and participated on a WHMIS subcommittee on the establishment of categories of controlled products. He is also writing the WHMIS training course given by the QFL.

Serge Trudel

The subject I was asked to speak on at this conference is training, prevention programs, and the qualifications of contractors and workers. As an introduction, I believe it would be appropriate to give an overview of the situation in response to what this morning's speakers said, since their perspectives are different from those of the trade unions. Our position is that exposure in the workplace should be "as low as possible"; and the best conditions, or the lowest possible exposure, will be attained not only by respecting a standard but also by providing the best possible working conditions.

As regards the buildings which form the subject of our workshop, the choice between removing or monitoring asbestos must be made based on the conditions observed in the buildings and the risk linked to each of these operations according to the information available. Our position in relation to asbestos is that it is a dangerous--very dangerous--material. This has become clear from the types of health problems it has caused. But we believe it is possible both to produce asbestos and to work in premises where asbestos is present without being exposed to dangerous conditions. In the building trade there are contractors who do good work for all types of projects and other contractors at the other extreme, "fly-by-nights." You see this in situations where certain conditions established by regulation have not been respected. You also see completed projects where standards have not been respected and where there are probably more fibres in the air than there were before.

The problem of replacement remains unresolved. This morning when Ms Stoughton was asked what material she used to replace asbestos, she knew the name but not what the product contained. Worker exposure is far from satisfactory. There are people, not the stewards but the workers, the journeymen who have been involved in this type of work, who have been subjected to exposures exceeding the standard even though there are much better and safer methods to guarantee an acceptable level for replacement products. By and large, the programs are simply not working. If we consider each area where there are exposures, we can see that workers involved in removing asbestos or in projects where there is asbestos are exposed to much higher concentrations than there would have been before.

Training, qualifications, and prevention programs are often seen as the answer to all problems related to working conditions. This solution must be seen as part of an overall approach not only for asbestos but for all health and safety issues; a total prevention approach--one which ensures that the contractor with his expertise will provide optimum working conditions for his employees. In Canada, there is absolutely no system in place requiring that people be certified as to their capability to meet the requirements of any standard. In general, the legislation does not impose any training program. Contractors are supposed to know what they are doing, but there is no formal accreditation requirement.

The subject of this training remains speculative because training is being carried out in the various provinces either by unions, by institutions subsidized by the government, or by consultants who go into companies to train supervisors and workers. This training has two main objectives: to enable the workers to identify work situations that put them at risk, and to provide safer conditions and thus the lowest possible exposure. There are three possible levels of intervention--low, moderate, and high--and through training those concerned should be able to look at a work situation and decide which of these three types of action should be taken.

The other aspect of a training program is the practical aspect: the trainee must do the work under the supervision of a trainer to then be able to ensure uniform conditions; s/he must actually remove some asbestos as part of the training. This practical aspect will enable the trainees to evaluate replacement materials, correctly identify materials, know how to respond, use the required control mechanisms--personal protective equipment to the different levels of exposure--and know the rights set out in the legislation.

It is not enough to say, "That is asbestos--it's dangerous." People have to be able to think for themselves; know their rights, be able to exercise them, and be able to recognize situations in the workplace where they can exercise them. During the training sessions it should be pointed out to workers that they have access to medical examinations if necessary.

There are several training programs which discuss the regulations in the provinces according to the three levels. Trainees learn who is to do the work, and the regulations require the contractors to have the necessary qualifications. This morning, we saw an example of this "certification" as it is carried out by a school board!

At present, there is no method nor any legislative provision for carrying out this certification. Among other things, conditions for certification should include methods for hiring qualified staff, using personal protective equipment and mechanisms for reducing contamination at the source, and some means of ensuring that employers have everything they need to intervene if necessary. The school boards use external expertise and very seldom call on their own employees. This might be a general solution when the requirements faced by the employer are such that the most effective way to proceed is to hire an outside contractor to install less harmful replacement materials after these materials have been proposed and evaluated by the employer. The contractor would also be responsible for disposing of the waste material as stipulated in the legislation.

The purpose of all this is to ensure that the contractor will be able to guarantee completion of the work under different conditions; that is, do the work without endangering either the employees or the success of the project.

A prevention program is an inherent part of occupational health. It makes it possible to go into action, make the first move, and determine how the work is to be carried out. We discussed planned maintenance for a bit this morning. The prevention program goes beyond this and enables us to correctly determine how we are going to do the work, where the problems lie, and how we are going to resolve them; it is mainly an action plan that takes into account our own problems. The prevention program must identify the regulatory requirements and propose ways to meet them. If there is asbestos present, it must be identified and a program set up to reduce exposure levels. The prevention program applies to all the problems in the workplace, ensures that the required training is

available, and ensures that a health program and environmental protection measures are in place in the workplace. In Quebec, the education, training, and health programs fall under the Health and Safety Committee. This committee must have the right of veto. And it is up to the employer to propose a prevention program.

For the building contractor or the employer who has asbestos on his premises, the principle of intervention in occupational health dictates that problems and risks and the ways to prevent them be recognized and identified.

With respect to the health program, it is clear that very little is being done in terms of intervention by a medical team in the workplace. The health program still consists of basic health care: record of exposure, hours of work, general state of health, and sometimes more extensive tests are recommended, such as spirometry and X-rays. X-rays are relatively insensitive methods of evaluation and should only be used once every three years according to the worker's level of exposure. The health program should consist essentially of primary interventions designed to identify workplace exposures and check out any complaints.

Basically, this all boils down to providing conditions that will enable the workers to perform better. This morning there was a lot of criticism of solutions that were seen to be very ineffective. We believe the difficulty lies in the fact that there is no mandatory certification or qualification. If the work of contractors or employers was subject to certification, it would be much easier to inspect the project and set up guidelines. In Quebec, this question was raised during discussions of the regulations, but the unions did not succeed in having certification added to the regulatory provisions, and I believe the problem remains unresolved. When someone asks us to intervene in a workplace by saying "We have a problem with asbestos and we want to have a contractor come in; do you have someone to suggest?", there is no way of officially checking which contractor has the skills necessary to do the work. Some would probably have the necessary skills because they have already done this kind of work, but there is a good chance they would have let all their workers go and would have to train new staff.

It is not enough to say that we need certification. There is a problem of uniformity across Canada. We do not need a single Canadian certification standard, but a general principle that would allow the jurisdictions involved in the workplace to agree on what constitutes training or a qualified contractor. This difficulty must be resolved at the national level as it was for chemicals through WHMIS (Workplace Hazardous Materials Information System). Some coordinated action must be taken at the national level to ensure that all contractors, whatever their origin, have received training which is recognized in the province where they will be working. For example, Don Pinchin is based in Toronto, Ontario, and he does work all over; there are not very many like this and at the present time there is no way of making sure, if he wants to work in Quebec, whether he is certified in Ontario and what value this certification has.

The accreditation and qualifications of contractors are not all that matters; we must also consider the position of the workers with respect to certification. It is not enough to have a governmental system; it must be a system where the workers have their say as regards obtaining an accreditation or certification and the conditions leading to this certification. Those who are to do the work must know the conditions under which it should be done and be able to correct the situation or improve the standards leading to accreditation.

Lillian Vine

The next speaker is Guy Perrault of the Institut de recherche en santé et en sécurité du travail du Québec, the IRSST. Following his presentation, Bette Meek will make a few comments on other mineral fibres.

Guy Perrault holds a doctorate in Organic Chemistry from the Université de Montréal. He was a researcher with the National Defence Department where he wrote numerous articles and papers on the chemistry of polymers, compounds, and surfactants. He also participated in the University of Toronto's program on bilingualism and biculturalism.

Since 1981, Guy has been working at the IRSST where he is in charge of the organization of the health and toxicology laboratories. He does applied research on environmental monitoring and the toxicology of the chemical contaminants in workplace air. He has published material on metal plating baths; asbestos and other mineral fibres; carbide, silicon, granite and silica dusts; metallic fume dusts; aromatic polycyclic hydrocarbons; and isocyanates.

I met Guy Perrault when he participated in our workshop in Hamilton on Man-Made Mineral Fibres. He was a member of the planning committee for our workshop today; as for many who have taken part in our workshops, and I hope this will apply to you all, he has become a good friend.

Guy Perrault

Now that the previous speakers have given you an overview of the question of asbestos in public buildings, my task is very simple: to briefly summarize what is currently known about the other mineral fibres that are found in a wide variety of building materials. I'll begin by giving you some background by defining a few of the terms I will be using during my presentation, and will then continue with a brief summary of the workshop of the Canadian Centre for Occupational Health and Safety (CCOHS) on Man-Made Mineral Fibres, which was held in Hamilton in October 1989. Then we will discuss some data on the concentrations of airborne fibres in public buildings during construction and after the building is opened and, finally, I will try to compare these concentrations to the situation in plants producing man-made mineral fibres to draw a conclusion on the current situation.

Other natural mineral fibres exist besides asbestos. You may have heard people talk about wollastonite, attapulgite, sepiolite and erionite. All these products contain mineral fibres and are used in commercial applications. However, none of these products is treated to extract the mineral fibres. Nevertheless the fact is that erionite is the natural mineral fibre with the highest carcinogenic potential of all natural mineral fibres.

But because of their volume of production and their commercial importance, I will confine my remarks today to the characteristics of man-made mineral fibres. Different terms are used to classify these numerous synthetic fibres. In North America, the following terms are commonly used:

- mineral wool, that is rock wool prepared from molten silicates and slag wool prepared from the slag from foundries or metal refining plants;
- glass wool prepared from molten silica;
- glass fibre manufactured from molten glass by a drawing process;
- and ceramic fibres of varied compositions which are ordinarily prepared from clay, metallic oxides, or other products.

The commercial applications of man-made mineral fibres are the same as for asbestos: thermal insulation, soundproofing, and the reinforcement of building materials.

At the CCOHS workshop on the use of man-made mineral fibres, two main questions were examined. First, why do we find a label reading "Possibly carcinogenic" on containers holding products that contain man-made mineral fibres? The second question was: As long as we have no conclusive data on the toxicity of man-made mineral fibres, how should the workers handle these fibres? Should employers wait to take protective measures or take immediate corrective action?

The answer to the first question is relatively simple. In 1988, the International Agency for Research on Cancer (IARC) classified mineral wools, glass wool, and ceramic fibres in the 2B category which means they are possibly carcinogenic to humans. Each of these fibres was put in this category for different reasons; nevertheless, when products are classified 2B by IARC, they must almost automatically bear the label we mentioned, "Possibly carcinogenic to humans," under Canadian legislation on hazardous materials (WHMIS). The continuous filament glass fibre was put in Category 3 by IARC; which means it cannot be classified based on the data currently available.

Those who participated in the CCOHS workshop reached a consensus on the second question. These participants represented manufacturing companies, employers, unions, governments, and scientists. The group rapidly came to an agreement on the need to take action immediately rather than waiting for more information on the toxicity of man-made mineral fibres. In practice, this action should involve establishing technical guidelines on how to use materials containing man-made mineral fibres. Another point that was brought up was the need to adapt air sampling and quantitative analysis methods developed for asbestos for man-made mineral fibres. However, there was a lack of consensus in the Hamilton group on the opportunity of imposing standards concerning exposure to man-made mineral fibres, or on the levels at which these standards should be set.

As regards the exposure of workers in public buildings, what is our current knowledge on the biological activity of man-made mineral fibres? According to our current knowledge, all respirable fibres causing fibrosis of the lung have certain characteristics in common. These fibres have a common geometry--length greater than 5 microns and diameter less than 3 microns--considerable durability in the lung, and they are found in relatively high concentrations in the air of buildings. Within certain technical limitations, scientists are able to take into account the concentration and the geometry of respirable fibres. They take samples of a known volume of air, count the fibres and determine their length, their diameter and the ratio between the two. However, the durability of the fibre in the lung is complex and remains an ill-defined parameter. Measuring and understanding the significance belong to the area of research rather than to the field of practical applications.

Until we understand the biological activity, and consequently the harmfulness or harmlessness of each man-made mineral fibre, the results of epidemiological investigations will be the basis for decisions concerning realistic worker protection. As was the case for asbestos, epidemiological studies, whether published or still underway, provide an insight into the situation in industries where workers manfacture man-made mineral fibres and products containing these fibres. The conclusions of these epidemiological studies are then extrapolated to the lower exposures in public buildings and to the more complex exposures on construction sites and in other places where these fibres are used. As emphasized by previous speakers, these extrapolations are based on a comparison between airborne respirable fibre concentrations in manufacturing plants and airborne concentrations in other places which do not lend themselves very easily to epidemiological studies. So it is important to compare these concentrations to put the risks in public buildings into perspective.

During its life, a building is, becomes, or will become a building site at some time or other. On one building site where glass wool insulation was being installed, the IRSST reported concentrations of airborne respirable fibres of about 0.01 fibre per cm^3 (Perrault, G., Dion, C. and Cloutier, Y. Sampling and Analysis of Mineral Fibres on Construction Sites. Submitted for publication, 1990). This concentration is approximately the same as the values found in industries producing glass wool insulation.

On two work sites where the rooms were more enclosed and less well ventilated than in the first case, the installation of mineral wool insulation produced concentrations of 0.34 and 0.20 fibres per cm^3. These concentrations were approximately the same as in some work stations in shops producing mineral wool.

In about 90 buildings in the city of Paris insulated with materials containing, among others, glass wool or mineral wool, Gaudichet et al. measured average concentrations of 0.000137 f/cm^3 (Gaudichet, A., Petit, G., Billon-Galland, M.A. and Dufour, G. Levels of Atmospheric Pollution by Man-Made Mineral Fibres in Buildings. In Non-Occupational Exposure to Mineral Fibres. Editors, Bignon, J., Peto, J. and Saracci, R. IARC Scientific Publications #90, pp. 291-303 1989). This is similar to the results given by previous speakers for buildings insulated with materials containing asbestos fibres. The same research team found levels of 0.000002 f/cm^3 for man-made mineral fibres in the outside air of Paris, a value lower than that observed in the public buildings. These results are 100 to 1,000 times lower than the concentrations found on building sites or in shops where man-made mineral fibres are produced. But a German researcher in Dusseldorf found a concentration of 0.000820 f/m^3--a much higher level than that found by Gaudichet (Friedrichs, K. H. Morphological Aspects of Fibres. In Dust and Disease. Editors, Lemen, R. and Dement, J. M., Pathotox Publishers, pp. 51-64 1979). As things stand it is difficult to compare the results obtained in different laboratories because sampling methods and the methods used to determine the concentrations of man-made mineral fibres have not been standardized.

What are the airborne concentrations of respirable fibres in work sites where insulation materials containing ceramic fibres are used or handled? On one building site, where successive layers of ceramic fibre insulation and glass wool insulation were applied around heating ducts in a very large plant, a concentration of 0.09 respirable fibre per cm^3 was found. Inside industrial ovens, enclosed and poorly ventilated spaces, average concentrations in ambient air of 0.96 f/cm^3 were measured. Friar and Phillips, researchers from the U.K., found concentrations of ceramic fibres between 0.1 and

1.75 f/cm^3 when they took measurements on 10 different building sites (Friar, J. J. and Phillips, A. M. Exposure to Ceramic Man-Made Mineral Fibres. In Non-Occupational Exposure to Mineral Fibres. Editors: Bignon, J., Peto, J. and Saracci, R. IARC Scientific Publications #90, pp. 299-303 1989). This shows clearly that ceramic fibre-based products are dustier and give off more fibres than other mineral fibre or glass fibre products.

However, there is too little information published on the airborne concentrations of man-made mineral fibres in buildings and on building sites to obtain a true picture of the situation. Researchers should be encouraged to gather and publish this environmental information even though it is difficult to obtain. The identification and quantitative analysis of airborne fibres is tricky work that must be performed with care by chemists who know what they are doing. And those in charge of public buildings must be aware of the complexity of this process and not become frustrated and impatient when a scientist says he must take samples a second or third time because the fibre concentration is too low, the density at the surface of the filter is too high, there is too much dust hiding the fibres, the results are too scattered, or for any other reason. Scientists still have their work cut out for them to succeed in devising methods of sampling and analysis for man-made mineral fibres that give accurate, dependable results in the various places where they are used.

We must remember, too, that a knowledge of all the different hazardous materials which may affect the health of those who construct a building or live in it is necessary to correctly assess the risk of exposure there. There are very few workplaces where workers are exposed to only one product, fibre, or contaminant. For several years now, research on asbestos has shown that dusts from asbestos-based textiles are more harmful to the lungs than the asbestos dusts in the mines without finding a satisfactory explanation for this phenomenon.

At this point I would like to present for your consideration the results from the identification and analysis of man-made mineral fibres which the IRSST[1] has gathered on different industrial or residential building sites where workers were installing insulation.

COMPOSITION OF FIBRES

GLASS WOOL

Loose		Respirable fibres	
Si :	58%	Si :	U.D.
Si > Ca > Ti :	24%	Si > Ca > Ti :	15%
		Ca S :	35%

MINERAL WOOL

Ca > Si > Al Mg, K, S:	66%	Si > Ca > Al :	30%
Si :	22%	Si :	U.D.
		Ca > S :	37%
		Si > Ca :	7%

U.D.: undetected

First, let us compare the composition of the fibres in insulating materials containing glass fibre to the composition of the respirable fibres on a site where workers install insulation. Loose insulation contains only two types of fibres. The basic composition of these fibres, as shown by an electronic transmission microscope with an analyzer of the dispersive energy of X-rays, includes silica and silicate. The airborne respirable fibres, however, do not contain a significant concentration of silica fibres. They do contain a certain quantity of silicate fibres whose composition is the same as that of the fibres in the initial product, as well as fibres containing Ca and S which are the preponderant components, and thus probably calcium sulfate fibres given off by materials other than the insulating material. There are all sorts of fibres of different compositions but lesser concentration on this site. Similarly, a mineral wool insulating material contained only two kinds of fibres when in loose form, silicates and silica, while the airborne fibres contained silicates and calcium sulfate.

COMPOSITION OF CERAMIC FIBRES

OUTSIDE OF FURNACE AND DUCT

Loose			Respirable fibres		
Si > Al > Zr	:	89%	Si > Al > Zr	:	55%
			Si > Al > Ca	:	10%

INSIDE OF FURNACE

Installation

Si > Al > Zr, Ti, Fe	:	86%	Si > Al > Zr, Ti, Fe	:	U.D.
Al > Si	:	10%	Al > Si	:	73%

Repairs or restoration			Si and Si > Al	:	13%
Al > Si	:	97%			
Cristobalite					
Mullite					

U.D.: undetected

An evaluation of the respirable fibres given off when ceramic fibres are used yields results which are every bit as complex. A first example involves covering a duct with ceramic fibre insulation which is then itself covered by insulation containing glass wool. The loose ceramic fibre insulation contains almost exclusively aluminosilicate fibres with traces of zirconium oxide. The airborne respirable fibres contain mainly fibres from the ceramic fibre insulation with only 10% of silicate fibres given off by the mineral fibre insulation. Note the confirmed absence of airborne silica fibres.

Ceramic fibre insulating materials that can withstand high temperatures are used inside industrial furnaces. Before installation, the loose insulation contains aluminosilicate fibres that contain small quantities of Zr, Ti, and Fe oxides. These fibres are accompanied by a small proportion--10%--of aluminosilicate fibre without any other metallic component. When the furnace is repaired or restored after being used at high temperatures for several months, a sample of the insulation taken from one of the inside walls indicates the presence of aluminosilicate fibres; the fibres containing Zr, Ti, and Fe have disappeared completely and cristobalite and mullite have appeared. When the workers simultaneously removed the old insulation and replaced it with new material, 80% of the airborne respirable fibres were aluminosilicate fibres. Clearly there is a marked difference between the content of the loose material and the composition of the fibres which a worker may breathe in if s/he does not use work methods adapted to the situation. Toxicological and epidemiological studies must take into account these scientific data to establish dose-effect relationships.

In summary, current knowledge indicates that long (>5 um), fine (<3 um), and durable fibres in the lung all produce similar health effects.

Materials made of man-made mineral fibres that have been installed in buildings give off only low concentrations of respirable fibres, probably as long as the materials are in good condition. There does not appear to be anything published on ceramic fibre-based materials installed in buildings.

During construction, renovation, or other operations where new insulating material is used, the airborne concentrations of man-made mineral fibres are comparable to those found in the shops where the fibres are produced when the work methods follow codes of good practice. However, the concentrations of respirable fibres increase notably in enclosed or poorly aired premises. In general ceramic fibre insulation gives off more dust than insulating materials which contain other man-made mineral fibres. The compositions of the airborne fibres may be very different from the compositions of the fibres in the original material.

Bette Meek

I would like to add a few points.

On the basis of available data for occupationally exposed populations, an International Program on Chemical Safety task group concluded that, generally, airborne man-made mineral fibre concentrations in workplaces with modern control technology are low. However, mean elevated levels similar to those estimated to have been present in the early phase of rock slag wool production in which an excess of lung cancer has been observed have been measured in some segments of the production and application industry, particularly spray application of insulation wool in confined spaces. The task group concluded that the lung cancer risk for these workers could potentially be elevated in the absence of precautionary measures to reduce exposure.

For the general population, it was concluded that is was not possible to quantitatively estimate the risk associated with exposure to man-made mineral fibres in the general environment. However, although available data are limited, levels of man-made mineral fibres in the typical general and indoor environments are very low compared to present

levels in most sectors of the industry and much lower than past occupational exposures associated with elevated lung cancer risks in the early phase of production of rock slag wool. It was concluded therefore that the overall picture indicates that the possible risk in the general population is very low if there is one at all and should not be cause for concern if current low exposures continue.

As in the case of asbestos in public buildings, current concentrations of man-made mineral fibres are not of concern to building occupants, but an increase of lung cancer could be associated with spray application of these materials in confined spaces during building construction in the absence of precautionary measures to reduce exposure.

In view of the potential risks to workers and the tendency for crumbly sprayed materials to break down over time, one wonders whether the continued spraying of materials containing any respirable mineral fibres in building construction is desirable.

To my knowledge, ceramic fibres are not widely used in building construction; they are used largely for high temperature applications. Until recently, the available toxicological data on ceramic fibre have been contradictory. There had been some increases in tumours in some studies in animals and not in others. Recently, preliminary results of an on-going inhalation study in hamsters in which the fibres were delivered more successfully to the lung indicate a high proportion of mesotheliomas in hamsters. Ceramic fibres are durable; they can generate fairly high airborne concentrations; and they have been shown to be pathogenic in animal experiments. Clearly, this is a material to which exposure should be minimized.

QUESTIONS AND DISCUSSION

Lillian Vine

The presentations have all been excellent; I hope the other members of my planning committee are as pleased as I am. Before you break into discussion groups, does anyone have any questions?

Guy Desjardins - FTQ Construction Local 99

I would like to ask Mr Perrault a question. In your conclusion you noted that the concentration of man-made mineral fibres on building sites, including sites where they are used in renovations, modifications, and other operations, is similar to the concentration measured in shops where the fibres are produced. Does this apply as well for demolition and removal?

Guy Perrault

The only time we took measurements during removal was for ceramic fibres. We took no measurements in the case of mineral wool or glass fibres.

Scott Houston - The Asbestos Institute

Bette, in April 1989 in Geneva a group of experts recommended that a code of practice be developed for insulation wools. Could you elaborate on what one could expect to be

included in that code of practice? Would it cover only the construction site in terms of installation of the materials and removal, or would there also be procedures for maintenance and custodial workers?

Bette Meek

I cannot really answer the question. I think that that would be open for discussion when in fact they do develop the code of practice. I think certainly there is concern for both, although the principal concern is in installation because of the sometimes high concentrations that have been measured in confined spaces during installation. The difficulty with the removal is that we just don't have any data at the moment. There may be good reason to be concerned, but we don't know.

REPORTS FROM HOMOGENEOUS GROUPS

Professionals/Government
Shal Gewurtz

Labour
Robert Bouchard

Management
Richard Boehnke

CCOHS/CCHST

Lillian Vine

Ladies and gentlemen, I always judge the success of a workshop by the difficulty I have in getting you to return to the plenary session. This time it was doubly difficult, not only to have you return after the coffee break, but also from your groups, where the discussions were very, very lively and I am very glad of that.

These three people have been chosen as rapporteurs for their group--Shal Gewurtz speaking for the Professionals/Government group, Robert Bouchard for the Labour group, and Richard Boehnke for the Management group.

The reports are the conclusions of the homogeneous groups of participants at this workshop; they are not the official position of these groups outside the workshop.

REPORT OF PROFESSIONALS/GOVERNMENT

Shal Gewurtz - Rapporteur

We conducted our discussions by focusing on the two questions before us: How can we make best use of public funds? How can we deal better with the issue of asbestos in buildings than we are doing now? We started our discussion by pointing out that there is a tendency to remove asbestos automatically for a number of reasons--one driving force being costs. We deliberated on the two options: spending money immediately for removal as opposed to spending money over a long period of time to manage an asbestos program in a building. There was a consensus in our group that management is the way to go and indeed is the only viable option; but we recognized that there are problems in advancing the concept of asbestos management programs.

For one thing, there are not enough consultants and we know not all are qualified. We discussed a number of possible solutions: perhaps government grants to sponsor training programs for consultants; the establishment of special government departments to advance the cause of management programs was mentioned.

We discussed public perceptions and public awareness. We came to the conclusion that public knowledge of the asbestos in buildings issue is generally lacking. There is a need for public education but the question is how to achieve that. There are problems involved in increasing public awareness of a complicated technical issue such as asbestos. It is a highly technical topic; the media tends to sensationalize it. Also inherent in the question of asbestos as a contaminant is that there is scientific uncertainty. We have heard that in the presentations and discussions at this workshop.

We recognized that even if an asbestos management program is well designed and well thought out, it must include an educational component.

These are some of the problems associated with public awareness and we tried to answer the question of how to overcome these problems. There was some debate about the effectiveness of public education programs; some thought that generally they do not work, but there was not consensus on this.

We felt that there could be research and development to develop better tools for evaluation of the asbestos hazard in a building, to develop cheaper and more effective methods for removing asbestos or managing asbestos in a building, and to develop cheaper techniques for testing and monitoring. Although research and development are necessary, they are time-consuming and it is important to set priorities.

We felt that at the workplace, the most effective vehicle for training workplace parties is through joint health and safety committees.

To promote public awareness, a suggestion was made about instituting some vehicle for public debate, recognizing that there is a great deal of public interest these days in environmental matters; recognizing, as was mentioned several times during this workshop, that the Royal Commission on Asbestos in Ontario that took place in the early '80s advanced the field significantly and is still looked on today with a great deal of credibility. Perhaps one should suggest either a Royal Commission or a Green Paper or some equivalent vehicle that would generate public debate. We do not mean a Royal Commission on asbestos but a Royal Commission or public debate on the general question of hazardous contaminants in both the environmental and occupational scenes. Through such a vehicle we would be able to increase the awareness of this complex issue.

REPORT OF LABOUR
Robert Bouchard - Rapporteur

Madam chairperson, I was quite interested in the proposal of governments and professionals that a commission be established to create public debate on all contaminants affecting workers as well as the nonworking population in the environment. A person may work in a foundry and be exposed to contaminants at "allowable" concentrations, and then go off work and enjoy standards that are much stricter. For asbestos, the public protection standard of 0.01 fibre per cc is 100 times lower than the workplace standard. The same holds true for lead: higher lead concentrations are tolerated in industry than outside. I believe the trade unions are right in considering a long-term strategy for active environmental protection. This way stricter standards will be attained than in the workplace, and then the workers can demand a "transfer" of standards.

Now let us move on to my report. There were 15 of us at this session who represented unionized workers, and I find this to be quite a good representation. We were all very glad that Quebec's Institut de recherche en santé et en sécurité du travail (IRSST) and the Canadian Centre for Occupational Health and Safety (CCOHS) decided to work together to organize this workshop. We hope this cooperation and these joint endeavours will continue.

It seems that the work undertaken by the Institute on workplace contamination by the other mineral fibres is probably the first of its kind to be conducted in the country. And it is very important for workers to know what is going on. Before considering prevention methods, we must determine exactly what kind of creature we are dealing with.

One thing our group noted is that lawmakers no longer have any reason for not adopting adequate legislation to protect the workers. You heard Mr Pinchin, among others, say that even in Ontario, which prides itself on being the first province--1985--to adopt regulations to protect workers against asbestos in buildings, some contractors systematically violate the law. No doubt this is because there are not enough inspectors, just as in Quebec. So we can imagine what is going on in provinces where there are no regulations at all or new regulations. In Quebec, it is total anarchy and the situation is probably the same in the other provinces. People are taken out of taverns and off the street, and are paid $7 an hour to do removal work at night; they are often exposed to very high intermittent concentrations of respirable asbestos fibres which put them at risk of developing this rare form of cancer called mesothelioma, for example.

My colleague Guy Desjardins mentioned that in the last few months two electricians have died of mesothelioma in Quebec. These electricians were putting in electric wires in petroleum companies where, as we all know, large quantities of asbestos are used as a covering for the pipelines. Dead at age 41 from mesothelioma! Because they did not take the necessary precautions and because employers did not tell the truth about the composition of pipeline coverings! Only now am I being told conclusively that some asbestos multinationals used mainly amosite and very often crocidolite to prepare these mixtures of "limpet" used as coverings for the pipes in a large number of buildings. Every time asbestos is disturbed, chrysotile--which according to scientists seems much less dangerous--is not the only material disturbed; amosite is disturbed as well, and these fibres are more dangerous and can cause lung cancer and mesothelioma. There is no excuse for not adopting regulations, either at the provincial or federal level.

As early as 1982, the International Labour Organization created a committee to produce a collection of guidelines on the safe use of asbestos. In the French version of this collection, pages 99 and following, and pages 78 and following, there are a large number of recommendations on the practices to use and methods to follow when removing asbestos or demolishing buildings. A Canadian by the name of Gordon Atherley, who was the president and chief executive officer of the Canadian Centre for Occupational Health and Safety, chaired this working group. These guidelines indicating the procedures to follow to protect the workers were published in 1984. The Ontario Royal Commission studied the question in depth. The Asbestos Convention (No 162) and the Recommendation (No 172) dealt with the techniques to follow and the precautions to take when removing asbestos and demolishing buildings containing asbestos.

In Quebec, the IRSST has certainly invested more than a million dollars in conducting research on asbestos-related diseases at the Unversity of Sherbrooke with Dr. Bégin's team. And this was done with the employers' money because the IRSST is financed by employer contributions. It would also be worth mentioning that the IRSST's scientific committee, which is in charge of decision-making and determines the organizations' research orientations, is tripartite.

We discussed worker training and the information they should receive regarding the removal of asbestos and maintenance work in buildings where there is asbestos. We looked at the experience of the western provinces and British Columbia in particular: the training program was set up jointly by employers and unions in the building trades, notably the dayworkers' union. It is a venture that was negotiated with the companies; employers contribute $0.15 an hour per employee to a fund that finances the training. These are new initiatives that follow the union training principles recommended by the Quebec Federation of Labour.

The training takes place on simulated asbestos removal sites. Simulated demolitions serve as a very concrete way of showing workers how to protect themselves properly. We see no better way. This practical training together with the theoretical training make it possible to overcome difficulties caused by functional illiteracy, as well as the difficulties some people have due to a lack of practical construction experience. We would like to see this method used all over the country. There are already 16,000 to 17,000 workers in America who have taken this basic 32-hour training course. In our negotiations in Quebec with the association of employers in the building trades, we have not yet been able to convince them of the necessity of having a 16-hour training course! Employers must understand that if we truly want to protect workers they must have the required training and information; and employers and workers must work together to reach these objectives.

It will cost employers less to give us adequate training than not to. Let me tell you why. The deaths of the two electricians in Quebec will cost a lot in compensation for the widows and the orphans. We in the trade union movement believe there is no better remedy than to practice prevention. Experience has shown that systematic training is the best form of prevention. This is our main recommendation. Of course, trade unions keep a jealous watch over the control that workers must exercise over the political content of the training they receive in occupational health and safety. Employers are legally responsible for the training and want to have their say, too, on what it will contain. But workers and employers can find common ground through their joint sectorial associations or through collective bargaining and standards can be established that will also apply to non-unionized workers. The weakness of the regulations now allows employers to hire non-unionized workers without training. The legislation must stop this slave labour.

In Quebec, the joint sector-based association, construction sector, is developing a list of recommended practices for asbestos removal and the demolition of buildings containing asbestos. This makes a lot of sense but employers must understand that they have got to place much more importance on prevention than they do now.

One of our recommendations is that we go beyond Recommendation 17 of Convention 162 of the International Labour Organization concerning the accreditation of companies. We have a problem in this area. I do not know the legislation in the other provinces well enough to comment on it, but I can talk about what happens in Quebec. The best we could get in Quebec is a promise from the Commission de la santé et de la sécurité du travail (CSST) that as soon as the inspector receives notice of the opening of a building site, he will go there immediately to check the contractor's operations: equipment, work methods, the qualifications of the workers, and the training given to those who remove asbestos or demolish a building.

We know that there are not enough inspectors in Quebec, and I am sure the situation is the same elsewhere. Governments absolutely must invest where it counts. There is not enough invested in inspection to ensure adequate prevention. To overcome this obstacle, both large and small renovation contractors should be made to conform to the rule on accreditation as regards having the necessary qualifications to do the work. We deplore the fact that the federal government has no specific regulation in the Canada Labour Code on the removal of asbestos. It could have set an example seeing that Canada was the second country in the world to support Convention 162 of the ILO in 1986.

We believe that what is lacking in Quebec and in most provinces is a mandatory procedure for checking public buildings to detect any asbestos to establish asbestos management or monitoring programs. The presence of asbestos must be known so maintenance workers in these buildings can be alerted. And we are suggesting the same means of solving the problem with other fibres, whether man-made or natural, as we are for the problem with asbestos fibres.

We recommend also that all occupational health and safety legislations in Canada, both provincial and federal, give workers the right of collective refusal. I had always believed that no law in Canada provides for the right to strike on health and safety questions, but then I learned that in British Columbia the Labour Code has provisions allowing workers to strike over occupational health and safety issues. There was even a test case in a pulp and paper mill. British Columbia's Labour Relations Board recognized the right of a group of electricians who had refused collectively to work in a room where there were PCBs. They had exercised their right to strike even while a collective agreement was in force, and British Columbia legislation gives them the right to do so. What concerns us here is the collective right to refuse dangerous work. If you want workers to be able to protect themselves against contractors who have no conscience (and they do exist) and encourage prevention, they must be allowed to cause crises sometimes by work stoppages.

We recommend the nonvalidation of an asbestos removal program in a building unless the program makes provision for evaluating the effects and consequences of the replacement materials that are to be used instead of asbestos. And we also recommend that a collection of guidelines be created as quickly as possible for the installation, handling, and removal of other fibres in the workplace, whether these are natural or man-made.

REPORT OF MANAGEMENT

Richard Boehnke - Rapporteur

We achieved consensus not without effort. We decided that public monies should go toward two large groupings--awareness and management.

With regard to awareness, most of us felt it would be useful to be proactive and have a general public information program. Some of the ideas, which need further work, could be one-minute television ads, messages in municipal tax bills, or insertions in income tax returns.

What was unanimously agreed was that there must be a central body of information. This would allow a proper response to asbestos situations, no matter what they are. The model for such a centralized body obviously was the Canadian Centre of Occupational Health and Safety in Hamilton, which would have and continue to develop a solid data base. This would permit decision-making tools to be made available to the community, as well as professionals. The information would be honest, impartial, tripartite, and accessible through a 1-800 number.

And it would be most important to implement and fund research into replacement materials and the technologies necessary to install them.

We must use all this knowledge we have ammassed to implement programs of management. We felt it important that there be absolute acceptance of the principles inherent in the Ontario Royal Commission Report and, in particular, that we accept the principle that proper management ensures a safe environment for all building occupants and the public. As a corollary to that, that there be consistency within the Ministries of the government respecting the Royal Commission Report; in Ontario, while the Ministry of Labour worries about asbestos matters, the Ministry of Education is giving money to school boards to remove asbestos, which is not consistent with the principles in the Ontario Royal Commission Report.

Further, we saw that there should be greater Ministry of Labour involvement in selling the principles of the Royal Commission. Some felt that this greater involvement might mean education, information or encouragement through some means. Some leaned toward the idea that there should be more inspection services.

As proposed by the Royal Commission Report, the operation and management plan concept must be put forward wherever asbestos is present in a building, so that a formal plan is laid out and carried out.

If removal or replacement is part of that operation and management plan, there are two major factors. The first is that accredited contractors have to be hired. Presently, that accreditation process does not exist; that is a function that needs to be developed. The second is that tendering documentation for the removal or replacement has to include recommendations on specific replacement material as selected by the client's consultant from whatever options for replacement materials might be available. It stands to reason that it is very difficult for the consultant to decide what replacement materials are appropriate if CCOHS does not have any research information on replacement materials and their risks.

Part of the package for management would be appropriate training for building managers and custodians.

I would like to relate to you an incident which shows the importance of the work we are doing at this workshop. This is not just another seminar; it is very real. The subject, the fears and trepidations are quite authentic.

I would like to read to you a media release I received from the Toronto Public School Board, dated September 11.

> Effective 3:00 pm on Tuesday, September 11, 1990, the Toronto Board of Education has temporarily closed West Toronto Secondary School pending the outcome of additional testing for asbestos. This precautionary action was taken after the Board was informed on September 10 by its consultants that small amounts of asbestos were identified above the ceiling tiles during the detailed survey undertaken as part of the Toronto Board's asbestos management program. This temporary measure will allow for further testing and the identification of any remedial measures that may be necessary. Staff and students at West Toronto Secondary School have been informed of the situation. Students have been asked to report to Western Technical Commercial School on Monday,

> September 17, 1990 at 1:00 pm, so that the situation can be reviewed and contingency plans for their ongoing instruction, if required, will be announced at that time. In the meantime, staff will be involved in planning for the resumption of classes. The staff at West Toronto Secondary School will be fully involved in the transition process for students...

What I have just read, we have talked about for the last day and a half. The Board, educated people who have all the tools that are available--the Royal Commission Report, their own synopses--still chose to close the school and send students onto the street where we know there is asbestos in the air. They did that for a reason, and we must try to address that reason through constructive, informative, factual material for the community at large.

The work we have done here and the conclusions we have reached are important. My only disappointment in this workshop is that there were not and there should have been media people here taking part in the discussions and listening to some of the problems they have to help us solve. We are here to learn what the truth is and how to tell the truth.

CONCLUSION

Lillian Vine

There are very many areas of consensus from this workshop. You all agree that management, prevention, training, and information are the key. You all agree that there must be involvement of the people who are doing the work. And that there must be accreditation. That the work must be recognized to be done well and for that you must have standards. You have asked both sponsoring organizations, the IRSST and CCOHS, to do more.

You are concerned about other fibres. You are concerned that unqualified workers may be ripping out asbestos; and that some years from now you may be discussing the dangers of the fibres used to replace asbestos and how to deal with that problem.

I want to thank each and every one of you for an extremely successful workshop because without you it can't happen. A special thanks to your rapporteurs, Robert Bouchard, Shal Gewurtz, Richard Boehnke, and to Alex Taylor, Peter Wrzesien, Robert Bouchard and Jean-Serge Denis who chaired the work groups, all of whom took on this extra work; to the planning committee; to the speakers--everyone and everything has been top rate. It has been a pleasure to have the IRSST co-sponsor this workshop; thank you. I am going to ask Louis Berlinguet to have the last word.

Louis Berlinguet

I want to put eight words before you, and how they relate to the discussions at this workshop.

We dealt with four points which seemed important and which I will describe rapidly. There was knowledge, which we discussed and which was presented by scientists; then the management of asbestos and the other fibres; control legislation which we call "regulations"; and finally the spread of knowledge or "education."

Those who know me know that I like to study problems but that I like finding solutions even better. And once these four words had been presented I asked myself what the solutions could be. I believe the scientists are responsible for finding them. They showed us that quite a bit is known about asbestos; I believe there is more research to do, but even more to be done on man-made fibres and applied research on management issues.

Those in charge of management, of course, are the managers. This is obvious but what also came out during the discussion is that there are several types of managers: managers of public buildings, of school boards, of private buildings. There is a whole range of managers who must take the necessary measures to manage their buildings, which they are more familiar with than anyone else.

As for the control question, the regulations, governments are responsible for this. The Departments of Labour, Health, and Education must work together to make these regulations.

Finally, there is education. In this area I believe it is clear that all of us are "in charge"; we all have a role to play. The media, which should have been here in much larger numbers, have considerable responsibility in this area. This responsibility is shared by the scientists, governments, sector-based assocations, unions, and by all of us.

And since we all share the responsibility, I must say that I am very glad you participated in this workshop, that you came in such large numbers despite all your regular occupations. I am glad of our association with the Canadian Centre for Occupational Health and Safety. This collaboration seems to me to be highly desirable if we want Canadian workers to benefit from scientific knowledge, training, and good management systems, and if we want governments, too, to be informed of the problems involved. Thank you for coming. Thank you very much, Mrs Vine.

Lillian Vine

Thank you, Mr Berlinguet. I thank you all for coming. Have a safe trip home. I will be looking forward to seeing you again.

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